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CCCXXXVI.—BOTANICAL EXPLORATION OF SIKKIM-TIBET FRONTIER.

The following documents have been forwarded to Kew by the Government of Bengal. They are reprinted partly on account of the intrinsic interest of the report, which deserves to be made more accessible, partly because it supplements in some respects the classical exploration of the same region made by the late Director of the Royal Gardens, Sir Joseph (then Doctor) Hooker, in the years 1848-9.

Mr. G. A. Gammie is an assistant in the Government Cinchona Plantations at Mungpoo, of which his father, Mr. J. A. Gammie, is the well known deputy superintendent.

238 packets of seeds, collected mostly at high level by Mr. G. A. Gammie, were sent to Kew by Dr. King, Superintendent of the Royal Botanical Gardens, Calcutta.

(No. 41B.S.I., dated Calcutta, the 26th July 1893.)

From George King, Esq., M.B., LL.D., F.R.S., C.I.E., Superintendent Royal Botanical Gardens, Calcutta, and of Cinchona cultivation in Bengal, to the Secretary to the Government of Bengal, Financial Department.

I have the honour to forward herewith in original the report made by Mr. G. Gammie on his botanical tour made on the Sikkim-Tibet frontier in the summer of 1892. This report was sent to his Honour the Lieutenant-Governor's Private Secretary on 28th April 1893, as Sir Charles Elliott wanted to see it prior to his departure for Europe. It was returned to me by the Hon. H. H. Risley on 26th June 1893, with a demi-official letter asking me to direct Mr. Gammie to prepare an account of the vegetation of Sikkim suitable for a Gazetteer.

Account of a Botanical Tour in Sikkim during 1892, by G. A. Gammie.

I departed to collect botanical specimens in Sikkim and on its frontiers on the 6th June 1892. As Mr. White, the political agent, informed me that he would probably be at liberty to accompany me on a journey to the little known district of Lhonak, I arranged to meet

him at Guntok in about six weeks' time, when we should make the necessary arrangements for our travelling together. To my disappointment, the exigencies of his appointment prevented him from carrying out his intention, and I was obliged to abandon the idea of going alone to Lhonak, as Mr. White considered it inadvisable on my part to attempt it while important negotiations concerning the frontier were pending with the Tibetans.

He kindly forwarded to me parwanas written in Tibetan and addressed generally to the headmen of villages, ordering them to render me whatever assistance I required, but at the same time he wisely advised me not to depend on procuring carriers or supplies from the inhabitants. His passports were of the utmost value to me on the rare occasions I had to avail myself of assistance from the villagers, a service these indolent people would have been loth to afford me had I not been supported by such indisputable authority. As I had no hopes of procuring supplies in the country, I made thorough arrangements for food sufficient for all to be sent at intervals to different stations, regulating my movements in accordance with the plans laid down, thus at all times avoiding a possible scantiness of rations, which would have disheartened my men and caused their desertion, a most undesirable contingency.

The slothful and improvident habits of the inhabitants prevent them from growing more grain than is actually necessary for their bare subsistence, a condition of affairs concomitant with their lack of mercantile enterprise, which is probably due to their isolation from the outer and more civilised world.

Being thrown on my own resources, and having permission from Mr. White to travel in any part of the country, excepting Lhonak and Cholamoo, I decided to devote the remainder of the allotted time to exploring the Lachung valley with its ramifications, the Lachen valley and the Chola range from Tumloong to the Zeylap La, from whence I could return to Darjeeling by the Gnatong road.

In anticipation of the meeting with Mr. White, I considered that the first month of deputation would be most usefully spent in traversing the Singalelah range to Kinchinjunga, from which I could march to Guntok by way of Yoksun.

As I was requested to confine my attention as much as possible to the collection and observation of temperate and alpine vegetation, that of low elevations being already well understood, I must omit anything but casual mention of the tract between Yoksun and Tumloong, and also the valley of the Teesta to the junction of the Lachen and Lachung. This restriction divides my narrative into three parts, the first dealing with the vegetation of the exceedingly moist mountains forming the western boundary of Sikkim, the second with that of the temperate and drier territory north of the junction of the Lachen and Lachung, and the third with that of the Chola range.

First Tour.—Journey along the Singalelah range to the tracts on the southern flank of Kinchinjunga, and the march across the valleys of the Ranjit and Teesta to Tumlung.

This excursion lasted from the 7th June to the 7th July. The rainy monsoon broke with almost unparalelled severity on the day of my departure, and the most interesting portion of the journey, namely, that at high elevations, was accomplished through incessant fogs and storms of wind and rain. I thus enjoyed few opportunities of viewing the surrounding scenery, and had perforce to confine my observations to the vegetation within access to practicable paths.

The Singalelah range is an elevated mountain mass, springing from the face of Kinchinjunga, and extending southwards to the plains of India. Owing to the facilities of travelling afforded by the Nepal frontier road to Phalut, the range so far is much frequented by general travellers, and is, in consequence, too well explored to induce one to linger on the way in search of novelties. Some yew trees (*Taxus baccata*) grow close to the road beyond Tonglu, and *Abies webbiana* is first seen on the last ridge between Tonglu and Sandakphu; from thence onwards it exists in profusion up to 13,000 feet in elevation, covering mountain sides with dense and sombre forests. There are trees of *Tsuga brunoniana* below Phalut, and *Juniperus Pseudo-Sabina* abounds near the path to Cheabhanjan; but the other species of conifers, so characteristic of drier Sikkim, are altogether absent. Above 11,000 feet the most notable plants are aconites and *Meconopsis Wallichii*, and a few species each of the genera *Ranunculus*, *Anemone*, *Potentilla*, *Primula*, &c. *Fragaria daltoniana* occurs here and there, bearing narrow oblong fruits, reminding one of small strawberries, and resembling them in flavour. The road from Sandakphu to Phalut passes through a forest of *Abies webbiana*, associated with *Pyrus foliolosa*, *Betula utilis*, *Acer caudatum*, and *Prunus rufa*, &c.; underneath them are thickets of various rhododendrons and two species of bamboo. One of the latter is *Arundinaria spathiflora*, which flowered two years ago, a fact attested by the dead culms still bearing the withered spathe-like sheaths of the inflorescence. Its average height is 10 to 12 feet. The other is what Mr. Gamble named *A. gammieana* from specimens of the foliage only, but having since examined flowers, he has discovered it to be *A. racemosa*, Munro, a plant which, although so abundant round Darjeeling as to be almost exclusively used as fodder for ponies, has never been known to flower there. The Phalut plant, which differs so much in size and appearance, having reddish stems with an average height of 3 feet, may, of course, owe its diminution to the more rigorous climate of higher levels preventing its attainment to a normal growth. These two bamboos, the most Alpine species in Sikkim, grow in impenetrable scrubs in the same spongy soil which affords support to rhododendrons and pines.

On the slopes immediately below the summit of Phalut arboreal vegetation is scanty, and confined to sheltered ravines. The ground is everywhere covered with a sward of herbaceous plants. *Anemone rivularis*, with blue and white flowers, predominates. *Primula rotundifolia* and *P. sikkimensis* (the latter affecting marshy situations in company with *Calathodes palmata*) are common. *Meconopsis Wallichii* is extremely abundant. The Bhutias eat the young stems of this plant, and the shoots of a *Polygonatum* are much esteemed by the Gurung shepherds. The young shoots of bamboos are cooked and eaten. *Rheum acuminatum* is prevalent throughout the whole of Alpine Sikkim, but is not utilised as food. *Allium Wallichii*, which is equally abundant, is consumed largely, sharing with the common onion the reputation of being an efficacious antidote against the physical discomforts experienced by men and animals at high elevations.

From Cheabhanjan onwards to Kinchinjunga the only available path is that used by the shepherds, who pasture their flocks along the whole range during summer. For many miles this track follows the contour of the spur's crest, so that every day's march comprises many descents and ascents. As might be inferred from the proximity of the path to the ridge, streams supplying a sufficiency of water for our camp were few and far between, often necessitating long marches to obtain our two

chief desiderata—a space large enough to contain our tents, and water for cooking. At the end of the first day we found such a place at Ewanangi, a halting stage for shepherds. Its elevation by B. P. thermometer was 11,174 feet. The camping ground was covered with young plants of the formidable *Cnicus eriophoroides*, a large thistle. At the commencement of this march we struck the Islumbo Pass, and continued in a northerly direction. The path runs through woods of *Rhododendron arboreum*, *R. cinnabarinum*, *R. Falconeri*, *R. barbatum*, and *R. Hodgsoni*, *Acer caudatum*, *Betula utilis*, *Pieris ovalifola*, *Juniperus Pseudo-Sabina*, *Abies webbiana*, *Prunus rufa*, *Arundinaria spathiflora*, &c. These trees grow so densely that very few herbaceous plants exist beneath them. *Saxifraga ligulata*, a few species of *Polygonum*, ferns of two species, and potentillas being most in evidence. A variety of beautiful mosses grow on the rocks. On open knolls the soil is carpeted with *Gaultheria nummularia* and the heather-like *Cassiope fastigiata*.

The following day's march was from Ewanangi to Megu. Two gentians become common about 12,000 feet. One, *Gentiana stylophora*, with large, terminal, greenish, lily-like flowers; the other *Swertia Hookeri*, conspicuous by its brown leaves and inflorescence, growing together in whorls on a stem often 6 feet high. A white and pink primula is common, *Rhododendron Anthopogon* is abundant. Its fragrant leaves are largely collected and burned as incense in Buddhist temples. Small trees are represented by the species of rhododendron formerly enumerated, to *Pyrus foliolosa*, *Prunus rufa*, and the bushy variety of *Juniperus recurva*, which forms excessively close thickets. *Spiræa bella* and *Pyrus rhamnoides* grow in open situations. *Clematis montana*, with large white flowers, climbs over bushes, and at once arrests attention. A succession of steep ascents and descents (where we first saw plants of *Meconopsis simplicifolia* in flower nestling under berberry bushes) was followed by a comparatively level path running over the rocks of glacial deposit, at the end of which lay the large and grassy flat of Megu, whose elevation by B. P. thermometer was 12,767 feet. Its bright green surface was interspersed with many plants of white primroses and yellow calathodes, a refreshing sight after travelling through such a long waste of rhododendrons. A colony of marmots lived in the rocks above the camping ground. I always understood that they avoid the damp climate of the Sikkim mountains, and live only in the dry regions beyond the snows. The tailless rat, another denizen of the same dry climate, was represented by numerous individuals scampering amongst the rhododendrons. A great extent of land beyond the camping ground is swampy, and covered with *Rhododendron campanulatum*. The stepping stones across the wettest parts are formed of slabs of a slate like gneiss, which are resonant when struck. Various species of *Sedum* of the section *Rhodiola* and the golden *Chrysosplenium alternifolium* are common in the clefts of stones, partly submerged in the water. The ridge above is steep, and its black barren crags of foliated gneiss present a most forbidding appearance.

The following day we marched to Gambothan. Since we left Phalut our marches had been along the crest of the Singalelah, excepting when we rarely descended to and traversed the Nepalese side; but here the path, after running through the swamp at Megu, ascends steeply and passes to the Sikkim side through a narrow depression guarded on each side by weatherworn cliffs. Grass covers this ascent, and the bright blue flowers of *Primula pusilla*, *P. glabra* and *Delphinium alpinum*, give an unique character to the place by their plentiful presence. In

the clefts of a rock we found a small simply pinnate *Polypodium* and a species of *Pellæa*.

The tract into which we emerged wore a different aspect to that we had just left. Above us towered enormous walls and pinnacles of bare rock, intersected by equally stony valleys, all tending towards the broad and terraced slope over which we marched without difficulty. *Rhododendron Anthopogon* and *R. setosum* were the only woody plants. On the sides of the rocks along the terraces *Saxifraga imbricata* and *S. jacquemontiana* grew in dense mosslike cushions, spangled with white and yellow flowers. The soil is covered with a thick turf of grass and sedges, amongst which are innumerable plants of *Primula Stuartii* and a species of *Anemone*. Beyond this first terrace the route led over alternate flats and ravines, and passed four lakes. At first the rocks near the path are scattered singly over the ground ; further on the whole surface of the hill is covered by a confused mass of glacier deposited boulders, where the path is marked at intervals by upright white stones. Very little vegetation, except moss, maintains an existence in this wilderness. Sir Joseph Hooker, in his admirable account of the Physical Geography of Sikkim, thus explains the cause of this barren desolation :—Glaciers again descend to 15,000 feet in the tortuous gorges which immediately debouch from the snows of Kinchinjunga, but no plants grow on the *debris* they carry down, nor is there any sward of grass or herbage at their base, the atmosphere immediately around being chilled by enormous accumulations of snow, and the summer sun rarely warming the soil."

Attaining a ridge marked by a rudely built monument, bearing a small flag, we descended a steep gorge down which a stream urged its turbulent course. Its bed was cumbered with gneiss blocks with many of a fine grained granite transported from higher levels. This stream effects a junction with two others to form the Rangbi river at a flat expanse called Gambothan. The sheltered situation of this place favours the growth of large pine trees, and copses of a willow, *Salix wallichiana*, fringe the river bank. From eastward another tributary flows through a broad grassy valley, which rapidly attains a high elevation, and for a short distance towards the south the united rivers flow calmly through a forest of *Abies webbiana*. The most noteworthy plant growing in the desolate locality we had traversed is the gigantic rhubarb, *Rheum nobile*, always associated in the traveller's mind with barren precipices, where they delight to grow, and where they heighten the weird effect of such scenery by their cadaverous stave like stems, for only by closer inspection can the actual beauty of the plant be realised. The only perfect specimens existed on inaccesible rocks, as the shepherds collect and devour all they find within reach.

The elevation of Gambothan by B. P. thermometer was 12,400 feet.

Leaving Gambothan, a steep ascent was made to the summit of the ridge—13,300 feet in elevation. For half the distance there is a scattered forest of *Abies webbiana*, *Juniperus recurva*, *Rhododendron campanulatum*, *Prunus rufa*, and *Betula utilis;* the upper part was almost wholly occupied by *Rhododendron Anthopogon* and *R. setosum* These, when bruised or trodden upon, exhale a strong perfume from the superficial glands with which they are covered, aggravating the headaches to which all are subject at high elevations. *Gentiana stylophora* is exceedingly common. Beyond the ridge is the broad open summit of Bokto, covered with grass, on which two large flocks of sheep were feeding. From this a descent has to be made into the valley of the Yangsap through dense growths of rhododendrons, *Abies*

webbiana, *Pyrus foliolosa*, and *P. microphylla*; beyond is a steep hill almost devoid of vegetation and covered with boulders. The path winds up its right flank to a depression below its summit at about 14,000 feet elevation. There is a good wood of *Juniperus Pseudo-Sabina*, and the shrubby vegetation mainly consists of a *Berberis* not yet in leaf. Descending somewhat we crossed two small plains with a steep low ridge intervening. On these level tracts, intersected with sheep walks, it would have been almost impossible to keep the proper paths had not the shepherds marked them with upright slabs of stones at regular distances. Leaving the second plain, a steep scramble along the inclined foot of an enormous black gneiss cliff brought us to the bank of Ratong river, on whose further side we camped on a flat grassy knoll, the only cleared spot in a waste of rhododendrons.

Next morning we took the Kanglalama path and continued up the valley towards the north-west. We crossed one or two alternating flats and transverse ridges, and surmounted a high spur, coming out on a large plain rendered exceedingly swampy by a network of shallow streams. It seemed of very large extent, but we could not define its boundaries through the fog. There was no inducement to stop or proceed further in this direction, so we retraced our way to within a short distance of our last camping ground, and then ascended a grassy slope to the east. The descent on the other side led steeply through grassy pastures in which grew a species of *Astragalus*, and a dark purple species of *Anemone*. The floor of this valley is also a succession of terraces, each terminated by a bank, over which the river pours in masses of foam. There are signs of a more varied vegetation later in the season, but at present there is very little scope for botanizing.

Primula denticulata and *P. reticulata*, resembling *P. sikkimensis*, grow on the verges of the watercourses. The valley lower down descends precipitately, and the flanks of its spurs are clothed with pine forests. The next day we halted at this place, called Rongjing by the shepherds. As rainy weather had prevailed without intermission since the commencement of this expedition, my men were quite disheartened, and being afflicted with complaints induced by wet and cold, begged me to hasten into the warmer valleys of Sikkim.

Being reluctant to subject them to further hardships in this inhospitable region, I acceded to their request, and informed them that I should go to Yoksun after spending a few days at Jongri, a locality I was anxious to see, as it was the goal of one of Sir Joseph Hooker's most heroic expeditions.

Returning to Tegyap La, we followed the course of the Ratong for about a mile, crossed it by a bridge and travelled eastwards up a very steep hill covered with rhododendrons; *Cryptogramme crispa* was plentiful along the path. The entrance to the undulating top of Jongri is marked by a shallow lake, said to be dry in the winter. We camped on a terrace immediately below two stone huts. Many plants were springing up amongst the grass, but the only ones in bloom were *Potentilla peduncularis*, *P. microphylla*, *P. coriandrifolia*, *P. albifolia*, *Primula reticulata*, *P. Stuartii*, *P. pusilla*, *P. glabra*, *Pedicularis siphonantha*, *Geranium polyanthes*, *Ranunculus affinis*, *Meconopsis simplicifolia*, and *Phlomis sp.* A majestic species of *Meconopsis* grew near the huts in dense clusters 2 to 3 feet high. The flowers vary in diameter from 5 to 7 inches, are an intensely vivid blue on opening, and change afterwards to purple. I was informed by the Bhutias that it was not a native of Sikkim, but had been introduced by them from Nepal. The mountain top of Jongri, which is admirably

described by Sir J. D. Hooker, is formed of alternating knolls and hollows ranging from 13,000 to 14,000 feet. Much of its surface is covered with *Rhododendron Anthopogon*, to the exclusion of other vegetation. To the east of the camping ground is a wood of rhododendrons, mostly *R. lanatum* and *R. campanulatum*. About 12,500 feet *Primula pulchra* flourishes on the rocks.

After staying a few days at Jonrgi, I marched down to Yoksun. For about a mile the path runs eastward along Jongri, and then descends steeply for 7,000 feet, enabling one to pass in review the gradation of vegetation from alpine regions to the sub-tropical zone. A few gigantic yew trees grow a little above the Ratong. After crossing the Ratong, we travelled along the slopes on its left bank by one of the most difficult and dangerous paths in Sikkim, to Yoksun. This place is unique from its peculiar formation amidst such precipitous surroundings. The copsewood which once enhanced the beauty of the flat is now reduced to a gaunt gathering of pollarded and charred trunks, but the beautiful little lake is still surrounded by forest trees. Here, and everywhere in Sikkim at the same elevation, there are large areas covered with *Edgeworthia Gardneri*.

I halted for two days to allow my men to recuperate in such a congenial climate. *Polypodium rostratum*, so rare in the Darjeeling district, is the commonest fern. As Mr. Gamble once told me that Mr. Levinge had found it growing on the same rhizome with *Drymoglossum carnosum*, I searched carefully for a confirmation of the fact, but I failed to find any instance of it; indeed I did not perceive one plant of the latter species.

Variety of ferns is a notable feature of Yoksun. The commonest are *Polypodium rostratum*, *P. membranaceum*, *P. lineare*, *P Boothii*, *P. fissum*, *P. amœnum*, *P. Lachnopus*, *P. argutum*, *Nephrodium hirtipes*, various varieties of *N. Filix-mas*, two forms of *Aspidium aculeatum*, one of *A. auriculatum*, *Oleandra neriiformis*, *Pteris aquilina*, *P. wallichiana*. Of Orchids I observed *Malaxis sikkimensis*, *Microstylis biloba*, *Cœlogyne ochracea*, *C. cristata*, *Otochilus sp.*, *Eria alba*, *Cymbidium hookerianum*, *Dendrobuim chrysanthum*, *Saccolabium calceolare* and a species of *Calanthe* in leaf. *Remusatia vivipara*, *Amorphophallus sp.*, *Arisœma speciosum*, *Hedychium coronarium*, and *Piper nepalenisis* were common on the rocks. The principal trees are *Erythrina arborescens*, *Castanopsis tribuloides*, *Pieris ovalifolia*, and two species of *Aralia*. The shrubby vegetation is composed of *Mœsa rugosa*, *Edgeworthia Gardneri*, and *Dichroa febrifuga*, *Camellia drupifera*, and a few other species. The villagers grow clumps of *Bambusa Falconeri* and a few plants of *Arundinaria hookeriana* have recently been planted near the lake. This beautiful bamboo abounds in Sikkim from 5,000 to 7,000 feet, and is the kind exclusively used for roofing temples and houses. For this purpose the culms are cut into short lengths, flattened out, and laid on as shingles. They are said to be very durable and make perfectly watertight roofs.

The cultivated crops are buckwheat, millet, and a little maize. After the grain is sown no care is taken to keep the fields in proper cultivation. One enclosed plot was full of ganja plants (*Cannabis sativa*) in splendid condition.

From Yoksung I marched to Tumloong through tropical and sub-tropical vegetation similar in all respects to that of the Darjeeling district.

By comparison with the drier regions of Upper Sikkim, which I afterwards visited, I considered that the main characteristic of the vegetation along the Singalelah range is its poverty in variety of forms

and its superabundant wealth in individual species of rhododendrons. I only collected about 200 species of plants in flower and fruit. There was, however, evidence to prove that the floral harvest would have been more remunerative later in the season. Dr. Hooker, in his appendix on the Physical Geography of Sikkim, states "their banks "(or rivers) between 8,000 and 14,000 feet are generally covered with "rhododendrons, sometimes to the total exclusion of other wooded "vegetation, especially near the snowy mountain, a cool temperature "and great humidity being the most favourable conditions for the "luxuriant growth of this genus." Such conditions prevailing throughout the Singalelah range, due to its proximity to Kinchinjunga, account for the overwhelming abundance of rhododendrons, and may also be accepted as probable reasons for the comparative absence of herbaceous plants (in ordinal and generic forms), which are unable to maintain a struggle for existence in such an adverse climate and against such formidable competitors.

Second Tour. The Lachung Valley.—I arrived at Tumloong on the 7th July, and was detained there until the 24th waiting for supplies which were delayed by the break of communications caused by the excessive rains.

Immediately on their receipt I commenced my second excursion, and marched through the hot tropical valley of the Teesta, arriving at Choongtam at the junction of the Lachen and Lachung rivers on the 28th. Near Choongtam a remarkable transition from tropical to temperate vegetation takes place, with no palpable increase of elevation. *Cnicus involucratus*, *Astragalus pycnorrhizus*, *Eupatorium cannabinum*, *Anemone vitifolia*, and a few other plants, served to accentuate the change. *Leptocodon gracilis*, a fragile climber with blue flowers, rambled over bushes everywhere. I collected many specimens of *Pleopeltis rhynchophylla* from a tree at the end of the Lachung cane bridge.

The hill above Choongtam ascends abruptly to 10,000 feet, and is almost entirely clad with grass alone. It forms the termination of a lofty range running southwards from Kinchinjhow, and divides the Lachen and Lachung valleys. The Tibetans aver that this long spur possesses but one practicable pass, namely the Sebo La between Momay Samdong and Tungu, but by dint of persistent enquiry I discovered that there are at least two more—one from Lachung to somewhere near Latong, the other from Yeumtong to Tallum Samdong. I was informed that they are rarely used, a fact explained by the lack of the necessity of frequent intercourse between the inhabitants of the two valleys.

From Choongtam we marched to the village of Lachung in one day. As far as Keadom the valley is narrow, and the path runs along the river bank for most of the way. Here the valley expands into a large flat, with an elevation of 6,600 feet, which enjoys such a warm and sunny climate that maize, millets, and other tropical crops are successfully cultivated. Onwards the valley again becomes narrow, but two or three miles below Lachung it broadens considerably, and remains open for some miles above the village.

A large proportion of subtropical trees and plants ascend to a short distance above Keadom. These are succeeded by a dense shrubby vegetation of *Hydrangea*, *Rosa macrophylla*, and *R. sericea*, *Prinsepia utilis*, *Pyrus*, *Pieris ovalifolia* and *P. formosa*, *Zanthoxylum*, *Rhododendron arboreum*, *R. ciliatum*, and maples, &c. Other plants are *Leycesteria formosa*, *Buddleia macrostachya* and *B. Colvillei*, *Berberis* and *Rubus niveus*, with palatable fruits. *Roscoea alpina*, the box-like

Sarcococca pruniformis, are in great quantity. The handsome fern *Osmunda claytoniana* overruns large areas in the manner of bracken at lower elevations. Two species of *Leucostegia*, *L. Hookeri* and *L. membranulosa*, with sweetly hay scented foliage, and a large stipitate form of *Pleopeltis simplex*, grow in a wood at about 8,000 feet. *Goniophlebium ebenipes* was in dense clusters on the tops of many of the numerous rocks.

This locality is eminently distinguished by its variety of coniferous trees. *Abies webbiana*, the dominant species on the humid mountains of the Singalelah and Chola Ranges, even here maintains its supremacy in numbers. It ranges from 9 to 13,000 feet. Up to 11,000 feet it grows intermingled with the other lighter foliaged pines, but from that elevation to its highest limit, it exists alone or associated with the equally dark coloured *Juniperus Pseudo-Sabina*, so that nothing breaks the monotony of their sombre aspect on the slopes which they clothe with their lofty forest. *Juniperus Pseudo-Sabina* and *J. recurva* are the two last representatives of arboreal vegetation, both attaining 15,000 feet, the former as a small, stunted, weather-worn tree, the latter, a prostrate intricately branched shrub. Large quantities of planks cut exclusively from *Abies webbiana* are annually exported to Tibet. Their preparation is an important industry of the inhabitants of Lachung, who shape the timber with no other appliances than the axe and wedge.

Picea Morinda and *Tsuga brunoniana* are found between 8,000 and 11,000 feet. The first is a tall conical tree with thick trunk and dark green pendulous branches, the latter has spreading branches, drooping at the extremities, and bears very small cones. *Larix Griffithii*, the only Himalayan Larch is restricted in its distribution to Eastern Nepal, Sikkim, and Bhutan, and previous to its rediscovery by Dr. Hooker, its existence was only known from a notice in Griffith's journals. It is pyramidal in outline, and attains a height of 60 feet. The branches are long and pendulous, supporting erect cylindrical cones closely resembling those of *Picea Morinda*. It first appears at 8,000 feet, becomes plentiful at 9,500 feet, and ascends to 12,000 feet. It is the only deciduous conifer in Sikkim, the leaves falling in autumn, to be renewed in the beginning of the following summer.

The Peach and Apricot introduced from Tibet are cultivated by the villagers at Lachung, but in no great quantity. I was informed that the fruits of both ripen in the end of September. *Pyrus sikkimensis*, a wild crab-apple tree, is common, but its austere fruit is only pleasantly edible when stewed with sugar. A little barley is reared, with radishes and turnips, which were the only vegetables I could obtain worth eating; their scanty yield of potatoes consisted of wretchedly small tubers, so waxy as to be nauseating when cooked.

The Tankra Mountain was within easy distance of Lachung, and as it promised a quick introduction to the Alpine Flora I was anxious to see, I determined to visit it at once. We crossed the Lachung river, threaded our way through the narrow dirty lanes of the village, and immediately climbed up the grassy slope above it. For about a mile the path runs through a dense herbaceous vegetation composed of the plants I formerly enumerated at Lachung. A beautiful small pink lily, *Lilium roseum*, grew profusely on banks, associated with *Roscoea alpina* and *Drosera peltata*. At 9,500 feet we passed through a fine grove of small trees of rhododendrons, maples, roses, *Lindera necsiana*, *Betula utilis*, and the laurel-like *Daphniphyllum himalayense*. In a mossy hollow within this wood I found a large quantity of the delicate

little fern, *Polypodium trichomanoides*. *Goniophlebium subamænum* depends from the trunks of silver fir and *Goniophlebium erythrocarpum*, another epiphytic fern, accompanies arboreal vegetation to the end. Passing the grove we entered the magnificent forest of pines which extends without a break to 12,500 feet. We marched to its upper skirts, where we camped after clearing a sufficiently large plot of ground near a stream, winding through an expanse of rhododendrons. Two species of *Cremanthodium*, *Polygonum vaccinifolium*, *Oxyria digyna*, *Pedicularis* of various species, *Potentilla fruticosa*, beautiful yellow and white *Saxifragæ*, Epilobiums, *Lactuca macrantha*, *Parnassia*, and aconites were the commonest plants observed.

The following day we held on our course upwards. The region of trees was soon left in the rear, and a low growth of *Rhododendron companulatum* succeeded, showing the dark glaucous tints of its unfolding leaves. The bladder headed *Saussurea* (*S. obvallata*) thrives on the damp margins of watercourses, and bumble bees were busy amongst its fœtid flower heads. These are in clusters of a dark brown colour, enclosed in inflated white papery bracts forming an ovate head, and yielding sufficiently to allow insects to insinuate themselves with ease. The woolly headed *Saussurea* (*S. gossypiphora*), delighting to grow in sandy debris, appeared at first sight to be only a ball of white fleecy wool. The flower heads when young are completely enveloped, but on the approach of maturity a ring opens on the top, disclosing the inflorescence inside. Another remarkable plant, in similar situations, is *Crepis glomerata*, whose carrot-like stem buried in the ground is flattened on a level with its surface, and bears a broad head of yellow flowers, surrounded by small radiating leaves pressed closely to the soil. *Rheum nobile* is visible on the faces of all the cliffs around, and ascends to 17,000 feet.

Our third day's camp was pitched below the ascent to Kanko La, which passes at the gorge, cut by the river through a low line of cliffs, forming a barrier across the head of the Tankra Choo valley.

The next day we crossed this by the frequented path, and followed the track to the Tankra Pass, which is at an elevation of 16,000 feet. The terminal valley slopes gently to the pass, is exceedingly rocky, and is bounded by snowy ridges, and much snow lay in its hollows. The rounded surface of the pass is a conglomeration of sand and boulders, which are constantly sliding down from the crags on either side.

On the Tibetan side a narrow grassed valley descends steeply. Fog effectually prevented a more extended view. Between the Kankola and the barren glacier below Tankra La there was a multitude of bright hued flowering plants. Brown and yellow *Chrysosplenium*, yellow *Saxifragæ*, blue and yellow forms of *Corydalis*, a few species of *Pedicularis*, beautiful small primroses—*Primula uniflora*, *P. muscoides* and *P. soldanelloides*, *Ligularia*, *Rheum nobile*, some blue gentians, and the bladder headed *Saussurea*,were the most notable. The plants I found on the pass are those enumerated by Dr. Hooker. In addition to his list, I may state that *Meconopsis horridula*, a lovely plant, affecting only the most inclement situations, was collected in full bloom from under the shelter of rocks. I stayed for two hours at the pass in the vain hope of the fog lifting to give me a better view. During this time the continuous winds were most variable, and the variability was rendered more obvious by the methods vapour was deposited by different currents. The wind which blew from the Tankra Valley on the south-west brought hail and snow, that from the south-east in Tibet precipitated rain. The same meteorological conditions prevailed

during Dr. Hooker's visit. The Tankra La is south of the summit of Tankra mountain, to the east is a long rocky ridge cleft by the minor pass of Kanko La, and between this and the culminating peaks is a large shallow basin with undulating surface, through which flow the head waters of the Tankra river. Those on the north spring from many points under snow fields, that on the south-east rises below the pass and is immediately lost in the great central moraine, reappearing at its lower end as a large and swiftly flowing torrent. It is joined near the Kanko La by the united streams from Tankra; after effecting the junction the river turns sharply to the west through the deep and narrow defile of the pass, and hastens precipitately downwards for some miles until it debouches in the Lachung river a little south of the village of that name. From the Kanko spur to the limit of pines at 13,000 feet the valley is broad and shallow; here it suddenly narrows and remains so to its termination. During the week I spent on this excursion, the weather was uniformly boisterous and wet, while those of my party who remained below at Lachung asserted that they had enjoyed calm sunny days and clear nights.

The fragrant spikenard, *Nardostachys Jatamansi*, is plentiful on Tankra, and the scrophularineous plant, *Picrorhiza Kurrooa*, intensely bitter when chewed, is abundant about 14,000 feet, and is held in much repute as a febrifuge and tonic. The only woody plant above 15,000 feet is the humble *Diplarche pauciflora*.

I returned to Lachung, where I halted for a week to dry the numerous specimens collected during the excursion to Tankra La, and also to make preparations for a journey to the Donkia Pass at the head of the Lachung valley, and the most northern point I could reach in Sikkim.

We started on the 13th August, and arrived at Yeumtong the same day. The path runs close to the west bank of the Lachung river the whole distance. About half way we crossed an enormous landslip, which had partly buried a large forest of *Abies webbiana* and larch.

The interesting feature of this day's journey was the extensive pine woods through which we travelled. On the western slopes they were scattered, on the east they grew down to the verge of the stream, and every tree was festooned with the long gray streamers of the Lichen, *Usnea barbata*. I was told that, when reduced to great straits, the Tibetans made use of this unpromising plant as food; when boiled it was said to be gelatinous and palatable, and as nourishing and life sustaining as beef.

We saw many tailless rats, but I was prevented from procuring specimens by my desire to respect the superstitious notions of the Tibetans and Lepchas regarding it. I was told, with every appearance of truth on the part of my informants, that the killing of one of these animals was certain to be followed by storms of snow or rain, according to the season of the year, and many instances of personal experience were related to me in corroboration of the fact. The Tibetans are also reminded of the near approach of winter when they observe these rats busy themselves in preparing their winter quarters.

The valley is wide as far as Yakcha; it then narrows for a considerable distance, broadening into large swampy flats, intersected with streams towards Yeumtong. The spurs on the western flank are precipitous, rocky, and sterile, supporting vegetation only at their sheltered bases, but forests clothe the opposite side with verdure. Every mountain mass in this region facing a southerly direction in the least degree

is, in summer, exposed to the full force of the damp southerly winds, laden with mist, which blow with increasing violence as the day advances, to die away only at night. These continuous currents rapidly disintegrate the surface, washing down the superincumbent earth, and wearing away rocks which become precipices or crags of fantastic shapes. Vegetation, therefore, cannot find permanent foothold under such circumstances, and its abundance is confined to the sheltered flanks, where a copious rainfall is absorbed by the deep and fertile soil.

The increase of 3,000 feet in elevation between Lachung village and Yeumtong causes the appearance of many new plants along the route. Composites become more numerous and gregarious. *Inula Hookeri* beautifies dry knolls with its densely leafy stems and large heads of yellow flowers. *Erigeron multiradiatus*, species of *Senecio*, *Anaphalis*, and *Aster* are equally plentiful. Various *Thalictra* and *Halenia elliptica*, all with blue and white flowers, grow in the grass and low thickets. Orchids are well represented by *Habenaria*, *Satyrium*, and the small purple *Orchis Chusua*, allied to the common *O. latifolia* of England. The monkshood was flowering and attained a height of 6 feet in flat grassy fields. Cattle and horses are allowed to graze at large in places infested with this plant, but sheep and goats do not possess the same instinctive knowledge of its poisonous properties, and great care has to be exercised by the shepherds when driving them through these localities.

Myricaria germanica, *Allium*, *Meconopsis simplicifolia*, whose spikes, 3 feet in height, greatly excel the stunted specimens seen on Singalelah, the large wild Rose, *Rosa macrophylla*, with bright red fruits, and shrubby *Berberis*, were all common.

The following day was Sunday, so I halted at Yeumtong. The tents were pitched between the huts and the river, which flows tranquilly in a broad shallow bed down the whole length of the flat. Opposite is the snowy mountain with a glacier reaching a lower level than any other in Sikkim, as Dr. Hooker mentions; a thick turf of grass covered the surface of the flat. A yellow Anemone, *A. obtusiloba*, with leaves appressed to the ground, a surculose *Saxifraga*, the Dandelion, *Taraxacum officinale*, the aromatic yellow *Elsholtzia eriostachya*, and groups of brilliantly yellow flowered *Senecio diversifolius* gave colour to the scene. A small swamp north of the camping ground was brightened by the yellow flowers of *Pedicularis tubiflora* and a small floating *Ranunculus*, and beyond, in a small wood of silver fir, I found many specimens of *Meconopsis simplicifolia* and *M. nepalensis* in fruit. I collected a large supply of seed from the former, but nearly every capsule of the latter had been destroyed by a small white caterpillar. Both species never grow in the open, but prefer the shelter afforded by rocks or small bushes on the skirts of thickets. The commonest plant was *Cnicus eriophoroides*, with strongly spinose leaves, which penetrate the thickest cloth, and cause a smarting sensation in the skin. Other plants were *Salvia glutinosa*, *Lychnis nutans*, *Cucabalus baccifer*, and *Asarum himalaicum*.

Aroids of the genus *Arisæma* are common. In early summer their tuberous roots are prepared and used for food according to the method described by Dr. Hooker. I was presented with a few glutinous cakes, made in the most approved style, but the taste was so peculiarly disagreeable that I could not persuade myself to eat more than one mouthful.

Yeumtong is a large cattle grazing station and depôt for Tibetan exports and imports. Communication thus far from the lower valleys

is kept open by the people of Lachung, who carry loads of planks, bamboo, rice, dye-stuffs, such as the leaves of *Symplocos* and the roots of *Rubia cordifolia*, which are transported by yaks to Tibet. In exchange the Tibetans bring down loads of salt, barley, blankets, and other commodities for the inhabitants of Lower Sikkim. I could not ascertain how may yak loads of merchandise are carried annually over the Donkia Pass, but every day during my stay in this part I saw herds of at least 10 or 12 yaks, and often many more, either going or returning. Looking northwards from Yeumtong, the slope of the valley to an elevation of 13,000 feet is easy, and is black with pine forests. Above, the land is red and sterile. On the west a tributary stream flows from behind Changokhang along the base of a long declivity of sand. The view higher up is cut off by jutting spurs below Momay Samdong.

The following morning we marched to Momay Samdong, elevation 15,300 feet. The first and the last two miles of the path are easy, but the intervening portion is steep. A forest of silver fir, maples, birch, *Pyrus*, rhododendrons, and others extends to 13,000 feet; for a few hundred feet further some scattered black Juniper trees occur; an equal distance is occupied by rhododendrons and willows, and passing the spurs which terminated the view from Yeumtong, the valley is broad, with enormous rocks on its surface, and the surrounding hills are rocky. I have nothing to add to the excellent description of this spot by Dr. Hooker, but a place with more inhospitable surroundings can scarcely be imagined. A few yaks were grazing, the sole survivors of large herds almost annihilated by an epidemic of rinderpest which raged during the previous year.

This great calamity had impoverished the inhabitants of the valley, as for the greater part of the year they depend for sustenance on the curds and cheese made from the milk yielded by their flocks.

As the morning of the 10th August was bright and sunny, holding out hopes of a fine day, a promise unfortunately not fulfilled, I set out for the Donkia Pass, seven miles, from Momay, and the most northerly point I could reach in Sikkim. The tracks lead through a waste of stupendous rocks, and the stream becomes divided into many channels. The hills rising arounded are masses of rock and rubble, forming a most forbidding landscape in the aggregate. The shallow waters support an abundance of reddish *Sedum* and *Rheum nobile*. Myriads of blue gentians unfolded in the brief glimpse of sunshine we enjoyed, and *Allardia glabra* grew in low dense tufts, bearing large sessile flowers with yellow disks and purple rays. The musk-scented *Delphinium glaciale* ascends to 17,500 feet, accompanied by *Aconitum Napellus*, reduced in size to a small plant with two or three leaves, bearing but one short pedicelled flower. Other plants were *Ranunculus lætus*, *Cyananthus* of two species, the edelweiss (*Leontopodium alpinum*), *Erigeron*, *Cremanthodium reniforme*, *Lactuca dubyæa*, *Crepis glomerata*, *Saussurea*, and the curious lichen-like *Antennaria muscoides*. *Rhododendron nivale* and *Ephedra vulgaris* were the only woody plants. The feature of the vegetation from 17,000 feet upwards is the prevalence of plants growing in dense hard hemispheric tufts, such as *Arenaria*, *Saxifraga*, *Saussurea*, *Astragalus*, and *Myosotis Hookeri*. The last steep ascent to the pass, 18,100 feet elevation, is devoid of vegetation. The view across Cholamoo to the Kambajong mountains was clear, and we were able to appreciate fully the graphic account of this wonderful region which Dr. Hooker gives in such perfect detail.

My orders forbade my crossing the Donkia, so I returned to Momay in the evening through a blinding storm of snow and rain.

As I was anxious to penetrate to the Lachen valley through the Sebo La, I waited at Momay for a week in order to obtain good weather for the attempt, but the cold south wind drove a thick mist and drizzling rain without intermission, and I was compelled to relinquish the idea. One day I went eastwards to the great glacier of Kinchinjhow. Passing the hot springs noted by Dr. Hooker, and climbing to the crest of the terminal moraine, we walked along the top of a lateral one leading far into the snowy billowy mass of the glacier. I was surprised to find many plants flourishing in such a bleak place *Eriophyton himalaicum* was common. It is a white woolly Labiate with bright blue flowers peeping from under the leaves; I have never observed it but on dry sandy slopes. The other plants were a minute *Saxifraga* with extensive runners, a small gentian, *Pedicularis* of three species, *Festuca*, and *Carex*. *Rhododendron nivale* was dead and withered, having probably been killed by the severity of the previous winter, but, strange to say, *Potentilla fruticosa*, in its largest and most developed form, and not the creeping variety we should expect to find here, was covered with flowers and foliage, and was as much at home amongst ice and snow as it is at the more temperate elevation of 10,000 feet. From Momay Samdong I returned to Yeumtong, and halted there a few days. I ascended to the glacier on the opposite side, which Dr. Hooker failed to reach through the gorge. Nowadays there is a cattle track leading to the high pastures, so that progress is easy. *Rosa sericea* is the commonest shrub in the pine forest and *Salix wallichiana*, *Pyrus microphylla* are all abundant. Between the summit of the first ridge and the glacier the path runs along the side of the stream; the rest of the area is too encumbered with boulders to be walked on with safety. Above 13,000 feet the forest of silver fir is replaced by penetrable rhododendrons, and a few stunted trees of black juniper. There is little variety in the herbaceous vegetation, the biting air radiating from the glacier being too chilly to suit even cold loving plants. *Podophyllum Emodi* with red fruits eaten by the Tibetans, *Swertia Hookeri*, *Rheum acuminatum*, and *Cnicus eriophoroides*, were conspicuous by their abundance and size.

The weather at Yeumtong was also uniformly wet and miserable, so I started for Lachung on the 20th August, arriving the same day. I stayed to dry my collections and to make arrangements for an excursion through the Sebu valley to Ghora La, a part as yet unvisited by any naturalist to my knowledge.

In his "Himalayan Journals" Dr. Hooker notes "about five miles "above Lachung the valley forks, the eastern valley leads to lofty "snowed regions, and is said to be impractible." A lofty precipice at the immediate entrance to this valley, and on its northern flank, attracted my attention. On inquiry, I discovered that one of my men had ascended to Ghora La, the first pass from the northern end of the longitudinal range which extends from Donkia to Gipmoochi, and forms the eastern boundary of Sikkim. From a distance the forbidding aspect of this valley would naturally lead one to conclude that to explore it would be a matter of great difficulty and danger. It is almost useless to interrogate the Tibetans as to the feasibility or otherwise of ascending any comparatively unfrequented valley, as their jealous exclusiveness prompts them to overrate natural difficulties in the hope of deterring Europeans and other strangers from exploring the various practicable routes to Tibet. The path to Ghora La runs up the valley of the Sebu river, a large and turbulent stream. I was informed that this valley is held in considerable veneration by the Tibetans on account of the lofty and unique precipice guarding its entrance, for the sacred mountain of

Donkia at its head, and also for the sacred inscriptions which were carved on the face of a cliff half way up the ascent to Ghora La; but this last feature is now completely obliterated, as the whole face of the rock has fallen down. At the summit of the pass, and visible from a considerable distance, is an irregular pillar-like rock, which I was told is the figure of a god, but its real character was apparent on closer inspection.

Leaving Lachung on the morning of the 3rd September, I took the following route. The Lachung valley path is taken for three miles to the village of Yakcha. Here the track to Ghora La breaks off abruptly to the north-west, a direction which is pursued more or less the whole way. A short walk through a forest, containing beautiful Conifers, *Picea Morinda*, *Tsuga brunoniana*, *Larix Griffithii*, brought us to the Lachung, which is crossed by a good wooden bridge. On the other side is a steep for a short distance, and afterwards the path runs almost level over somewhat swampy ground. The River Sebu, which, from its source downwards, is a swiftly flowing torrent coursing through a boulder strewn channel, here becomes broader, shallower, and more tranquil. Small willow trees fringe its banks, with *Euonymus* and *Ilex intricata*, while Thalictrums are specially abundant. Beyond a sudden ascent is made along the base of a stony precipice with *Woodsia lanosa* growing in its clefts, and a little further on I found its allied species *Woodsia elongata*, the only occasion I recollect of their association, as the former affects a more alpine elevation as a rule. The remainder of the day's march is steep, through a large forest of silver fir, until we arrive at the first convenient camping ground, a cattle station named Sebu, artificially formed by a clearance in the forest. Here *Ainsliæa pteropoda*, *Heracleum*, and *Galeopsis Tetrahit* monopolised spots untrodden by cattle.

The northern side of the valley is enclosed by a continuous precipitous spur, broken in one place only by a deep forest clad depression. At the foot of the chief one at the commencement of the valley is a small temple, where services are held on certain days of the year. The range on the other side being more gently sloped, is covered with forest and succeeding smaller vegetation, and is more diversified by ravines.

Of trees which do not extend above 10,500 feet in this valley, are *Picea Morinda*, *Tsuga brunoniana*, *Larix Griffithii*, *Prunus Padus*, *Pyrus lanatus*, *Pyrus sikkimensis*, *Hydrangea*, *Ilex dipyrena*. Above this elevation to 13,000 feet is a continuous forest of *Abies webbiana* maples, birch, viburnum, *Berberis*, and rhododendron; *Aconitum Napellus* grows luxuriantly on the grazing ground at Sebu.

At 11,000 feet large trees of *Juniperus recurvus* appear, and at 13,000 feet (the upper limit of *Abies webbiana*), and for a short distance above it, they form the only arboreal vegetation.

From 13,000 to 15,000 feet there is an impenetrable growth of rhododendrons and willows, with numerous small trees of *Pyrus foliolosa* and *P. microphylla*, and intermingled with grass. Underneath these bushes is an equal luxuriance of herbs, such as aconites, species of *Senecio*, *Saxifraga*, *Primula*, *Potentilla*, *Polygonum* and Thistles. *Cnicus eriophoroides*, which is moderately common in most valleys, is so abundant here as to be a perfect pest.

From Sebu (12,500 feet) the next march was to a yak grazing station named Sethang, at an elevation of about 15,000 feet. Up to 14,000 feet the floor of the valley is very steep, but about 1,000 feet below the level of Sethang we emerged on a swampy flat, through which the Sebu flows in several channels. Its surface is covered with grass, and its borders are

cumbured with *Rhodendron Anthopogon*. A tributary from the west pours over the hollow of a precipice in a magnificent waterfall. Above the plain is a steep rocky barrier thrown transversely across the valley. On reaching its summit we arrived at the camping ground. The coolies took up their quarters in the deserted huts, and my tent was pitched near an accumulation of enormous boulders. A small muddy pond lies at the upper end of the flat.

Here the two branches of the river Sebu unite, one rising in Donkia, the other in the nameless snowy mass south of Ghora La. The former is seen flowing in a deep and narrow gorge; the latter rushes down a steep rocky transverse slope similar to that which we ascended below Sethang. Both run parallel to each other, and are probably the terminal moraines of the glacier, which is now confined to the head of the valley. *Rhododendron companulatum* is the common shrub. *Primula Stuartii*, *Meconopsis nepalensis*, *Geranium collinum*, all in fruit, abound on the flat.

On the following morning I walked to Ghora La, elevation 17,000 feet. The path descended into the stream from the Donkia, the ascent beyond winds amongst gigantic boulders on the western side of the slope. At the top is another small plain, and the remaining portion of the valley becomes broader and ascends by a long easy gradient to 16,500 feet.

From this onwards to near the head of the valley is bounded with uneven ridges and unbroken slopes, which are possibly the lateral moraines of the ancient glacier terminating below Sethang.

Both seemed to be elevated 500 feet above the river. A broad terrace runs along the base of the eastern one for some distance. Higher up the valley expands and the stream again divides. The eye, following the course of the western branch, is carried to the snowy mountain of Forked Donkia, from whose feet a glacier spreads out over a large area.

There is an accumulation of rocks and sand at the eastern termination of the glacier, and its waters feed a lake white with suspended silt. This mountain is an object of worship and veneration, and votive offerings of prayer, printed cloths, fluttered on the banks of the lake. Between Forked Donkia and the pass is a shivered line of crags devoid of snow; the pass itself is an extremely narow gap, with sheer rocks rising sharply on either side. Its final ascent is occupied by a glacier which widens out eastwards into an enormous field of ice under another snowy mountain. The actual ascent of the pass is commenced at a small pool at the end of the glacier. There is no permanent path amongst the shifting mass of rocks, so we had to make our way as best we could up the lateral moraine of loosely poised boulders. Half way up we took advantage of a small snowfield. The last hundred yards was over the glassy surface of the ice, in which we cut steps as we advanced.

The available standing room on the pass would scarcely suffice for 10 men, and the descent on the Tibetan side is startling in its steepness. Its surface was covered with a shoot of stones. This pass is not practicable for the passage of yaks, and is seldom used by foot travellers. On the north a high naked hill projected eastwards, appearing as a huge pile of stony debris; on the south a large glacier descended. Below lay the broad open grassed valley of the Ridu Chu; beyond were a few isolated rounded peaks surrounding elevated plateaux of large extent, and further back still were mountains of the same dull red colour running east and west, and over them hung heavy masses of clouds which

obscured more distant views. The lower part of a snowy mountain, said to be Chumulhari, was seen in the far east.

The district we overlooked is called Kamboo. Medicinal hot springs of great repute occur in it. Phari is to the south-east of Ghora La, but it is hidden behind intervening ranges.

The vegetation above 15,000 feet in the Sebu valley is very scanty. *Sedum* of two or three species, *Saxifraga*, *Allardia*, *Meconopsis horridula*, *Cyananthus*, *Gentiana*, *Saussurea* of three species, *Ephedra*, *Rhododendron nivale*, and a few other plants, principally grasses and sedges, form the bulk of the vegetation. *Rheum nobile* grows on the surrounding otherwise sterile heights, and attains an elevation of 17,000 feet.

We found a woolly *Saussurea* (*S. tridactyla*) at the foot of the ascent to the pass, but from thence upwards not even a lichen was visible. This *Saussurea* and *Antennaria muscoides* are supposed by the Tibetans to be the most esteemed of their gods as incense. The plants used in temples are *Rhododendron Anthopogon* and *R. setosum* and juniper. I could not obtain definite information as to the derivation of the name "Ghora." I was first told that the sacred pictures carved near it suggested its name, and I concluded that the name was a contracted form of Gorucknath; afterwards it was explained that the meaning was "winding," in allusion to the winding route to the pass.

Yaks are grazed from 14,000 up to 17,000 feet in this valley during the summer, and at Sebu there was a large herd of cattle.

From Sethang I returned to Lachung in two marches, arriving on the 8th September.

The time until the 14th was devoted to arranging and packing our collections and luggage. We returned to Tumloong by the Teesta valley path, and arrived there on the 20th September.

Third Tour. The Chola Range.—I left Tumloong on the 22nd September for my third and last excursion. The first march was to Rungpo, elevation 6,000 feet, a halting stage of the Sikkim Rajas during their journeys to and from the Chumbi valley, their favourite summer resort. The path descends through cultivated fields to the beds of two arms of the Ryott river, which join a little further down. They are crossed by cane suspension bridges. The succeeding ascent is steep through many fields of dry ground rice and millet. An edible variety of Job's tears (*Coix Lachryma*) is grown near watercourses. The whole valley is thickly populated, and the inhabitants practice a careful system of cultivation.

An Oak, *Quercus semecarpifolia*, is common at Rungpo, but the rest of the vegitation is of the usual type at this elevation.

Onwards to Chola Pass the marches are made eastwards up a continuously steep ridge. The second day's journey brought us to Laghep (10,400 feet), a small cattle station with a camping ground on a projecting knoll covered thickly with *Iris nepalensis*. This locality is celebrated for its variety of rhododendrons, every species existing in Sikkim, excepting *R. nivale*, being found within a distance of two days' short marches. It was too early in the season to obtain seeds, as they do not ripen until November.

The plants of *Decaisnea insignis* which Dr. Hooker observed at 7,000 feet still grow abundantly there.

The next day's march was a short one to Pheyeuggong, 12,400 feet, a large flat topped peak, where *Abies webbiana* is first seen. Beyond Pheunggong we descended to the Rutto river, where we found quantities of *Cathcartia villosa* in fruit. This plant is extremely local in its

distribution, being found only in this small valley and in one small area near the summit of Lingtu. The ascent continues along the broad valley of Rutto, which becomes bleak upwards. *Abies webbiana*, however, attains an elevation of 12,600 feet at Chamanako, where we halted.

The first part of the ascent to Chola Pass is very steep, an easy path then leads to the next ridge, beyond which is a small and pretty lake. A second slight ascent brought us to another small lake, and a pond lies immediately beneath the pass. The summit of the pass is rounded, and its surroundings are barren rocks. On the Tibetan side a narrow gorge like valley descends sharply. Snow had fallen the previous night, descending to 13,000 feet. We left Chamanako on the 28th, and resumed our journey along the Chola range. The path follows the course of the Rutto for half a mile, then crosses it, and an ascent to 14,000 feet follows, through a scrub of rhododendrons. At 14,000 feet there is a large hollow covered with rhododendrons, containing two lakes, the larger ovoid in shape, the smaller is long and narrow. Attaining the ridge beyond, we descended to the River Rungpo, passing through on the way a narrow defile walled with rock. Another ascent through small rhododendrons again follows, after which we descend, and strike a path from Guntok. We walked along this for a mile, and reached the camping ground named Buthan, a large expanse of green turf closed in on the east by a barrier-like cliff.

During this march we found specimens of *Chrysanthemum Atkinsoni*, the only example of the genus occuring in Sikkim, some small Saussureas with fern like leaves, primroses, *Parnassia*, the bladder headed *Saussurea*, *Senecio amplexicaulis*, and the small rhubarb *Rheum acuminatum*.

The following day we marched to Kapup, a small plateau under Zeylap La. We ascended to the top of the rocky barrier east of the camp. From here we obtained a magnificent view of a long trough-like valley terminated by a ridge beyond Kapup. The whole scene was of a warm brown colour from the herbaceous vegetation, killed by the late autumn frosts. This valley, which runs southwards, is bounded on the north by the main Chola ridge forming the political boundary between Sikkim and Tibet. There was a long gradual descent down this remarkable valley, in which are two marshy lakes of considerable extent. Beyond the second lake a deep narrow gorge intervenes. This is clothed with pine forest, and at the end of the valley the meeting of two opposite spurs held back the stream to form a large lake reflecting the pine woods on its dark tinted surface. Surmounting the ascent from the stream, we emerged on the grassy flat of Kapup with a few scattered silver fir trees, small rhododendrons, and shrubby *Berberis* in its sheltered parts. The spikenard, *Nardostachys Jatamansi* was common, but few plants grew in the closely cropped herbage.

On the 30th September I walked to the pass, and returned through Kapup to Gnatong. No vegetation exists at the pass itself, and that below it was fast withering. At Gnatong the plants still in flower were *Onosma*, *Senecio*, and various *Saussurea*, *Swertia*, and *Saxifraga*. From Gnatong I travelled by the military road to the Teesta bridge, arriving at Mongpoo on the 5th October.

During the whole of this excursion I had only one fine day, namely, the 28th September; a dense fog with drizzling rain prevailed the rest of the time, to my disappointment, as it prevented me from noting the details of the scenery I passed through.

Sir Joseph Hooker to Royal Gardens, Kew.

The Camp, Sunningdale,
My dear Dyer, October 29, 1893.

I am very glad to see Mr. Gammie's "Botanical Tour in Sikkim" reproduced in the *Kew Bulletin*, a mark of appreciation which its interests and value well merit. The perusal of it strengthens in me the opinion which I have long entertained, but which I have never formulated, that Sikkim, for its area, presents one of the richest, if not the richest, botanical regions on the globe. And further, that though no more than about 40 miles from east to west, and 100 from north to south, and situated beyond the northern tropic, I believe that, when all that is known of its vegetation shall have been brought together, it will prove to be a better microcosm of the flora of the globe than any other area of equal or even of much larger dimensions.

Thus, in its alpine region, the floras of the European, Siberian, Chinese, and American mountains are all richly represented, and there also are found the principal types of the steppe and desert vegetations of Tibet and Central Asia. In its temperate region European genera abound in species in greater numbers than they do further west in the Himalaya, or probably than they do further east in the same range, where different climatic features prevail; and in the same region types of Chinese, Japanese, and North American (both eastern and western) genera appear in force, and which rapidly disappear in advancing toward the Western Himalaya. Lastly in the tropical region, the Malayan flora disputes precedence with those of the plains and lower hills of the Indian continent, Burma and Ceylon, as represented by genera and species, many of which are also characteristic of tropical Africa. In short, with the exception of the prevalent types of the Australian, South African, and South American floras, there are few others that do not meet the eye of the wanderer in Sikkim.

In respect of the temperate and alpine floras of Sikkim, Mr. Gammie's indefatigable exertions and fruitful observations have put all this before the naturalist's eye with remarkable lucidity, and added largely to our knowledge of this province of the Indian Empire.

Ever affectionately,
The Director, (Signed) Jos. D. Hooker.
Royal Gardens, Kew.

CCCXXXVII.—POLING IN AGAVE PLANTS.

The progress of the fibre industry in the Bahamas has been fully noticed during the last four years in the pages of the *Kew Bulletin*. At the present time the earlier plantations are approaching maturity, and it is anticipated by those interested in the subject that the export of fibre on a commercial scale will probably begin next year.

In the meantime a question of some importance has arisen in regard to the duration of life of the particular sort of *Agave* cultivated for fibre purposes in the Bahamas.

This is botanically known as *Agave rigida*, var. *sisalana*. It is a dark green, smooth-leaved sort (with no marginal teeth) originally introduced, either directly or indirectly, from Yucatan. There it is known under the aboriginal name of Yaxci.

The plant more generally cultivated for fibre in Yucatan is a glaucous-leaved sort, armed with small, black, marginal teeth (*Agave rigida*, var. *elongata*), known locally as Sacqui. The Bahamas plant, the Yaxci, is still also found in Yucatan, but apparently it is not specially selected for general cultivation.

Of *Agave* plants, a familiar example, grown in green-houses in this country, and sometimes put out for decorative purposes during the summer months on lawns and terraces, is that commonly called the American aloe (*Agave americana*). Such plants produce nothing but leaves for the greater part of their life. In this state they may last for many years. In some species there are also occasionally produced root suckers, which afford a ready means of increasing the plant. This, however, is a purely vegetative reproduction. The exact life-period of Agaves in northern latitudes may vary from 10 to, possibly, 50 years or more. On account of this exceptional longevity amongst succulent plants they are sometimes called Century plants. In the tropics, grown under natural conditions, these plants seldom last longer than seven to 12 or 15 years. Sooner or later, however, within the periods above mentioned, and depending on the conditions under which they are placed, they throw up a "pole" or flowering stem. On this will successively appear the flowers, the capsules bearing seed, and possibly also numerous bulbils. In some species there are produced abundant seeds, but no bulbils; in others there are produced bulbils only and no seed. The ripening of the seed or production of bulbils, whichever may be the normal habit, brings the life of the plant to a close. After this the whole plant withers and dies

The question raised in the Bahamas, and respecting which the aid of Kew has been sought, has reference to the exact length of time the Yaxci (*Agave rigida*, var. *sisalana*) may be expected to last in the leaf state. In other words, how long can the plant be made available to the planter for the production of fibre? The matter is naturally one of great interest to the Bahamas people, for on it hangs the success of their plantations. The result of the inquiry at Kew is given in the following correspondence. It is so far satisfactory that, with care and judgment on the part of those directly in charge of the plantations, there need be no greater cause of anxiety in the Bahamas than has been felt during the last 30 years in Yucatan, for plants that have poled might easily be replaced from time to time by strong healthy "supplies" from nurseries, and the work of the plantations need not at any time be seriously interrupted.

Mr. Neville Chamberlain to Royal Gardens, Kew.

Memorandum.

July 26, 1893.

Information has been received from the Bahamas of a somewhat serious nature in reference to the Sisal industry. It will be remembered that in the wild state these plants pole when about seven years old, but it was supposed that the cutting of their leaves when cultivated would delay the poling and prolong the life of the plant, as is said to be the case with the Yucatan variety. It is said, however, from observation of old plants in the Bahamas, that cutting makes no difference to the life of the plants, which seldom exceeds seven years. As four years at least are needed for the growth of the plants before they are fit for cutting, this only leaves between two and three years of cropping, in which the planter must recover all the capital expended in their cultivation. Any suggestions by which the life of the plants might be prolonged and poling

prevented are invited, as the early poling will gravely affect the success of the industry.

N. C.

THE MONROE FIBRE CO., LIMITED, to ROYAL GARDENS, KEW.

DEAR SIR, Abaco, Bahamas, July 20, 1893.

THE interest shewn by your department in the fibre industry of this Colony, and the valuable information you have already afforded in connexion with the plant, have prompted me to submit the following questions, which deal with points of prime importance to those engaged in its cultivation. In fact I do not know to whom else to apply, for our plant is undoubtedly different from that commonly grown in Yucatan, and no one in the Bahamas seems able to speak with certainty upon the subject under review.

Our plant, or "Bahamas Hemp" as it is now termed, is an Agave with dark green leaves, which are spineless except for a thorn at the tip. From all accounts it is identical with the "Yaxci" of Mexico.

1. The life of the "Sacqui," which is that generally grown in Yucatan, is said to be from eight to 16 years after cutting has been begun. Can you tell me whether our variety enjoys as long a life or not?

2. Do Agaves put out during their life a certain fixed number of leaves, the normal quantity varying but little between plants of the same species, or is there no regular limitation in this respect?

3. If the output of leaves on a plant is variable, would cutting them as they mature be likely to increase it, and, judging from analogy or otherwise, ought the cutting to be made several times a year or at any particular seasons? Also, would cutting the leaves have the effect of prolonging the life of the plant by retarding its poling?

It may seem strange to ask for such information when we have the plant here growing under our eyes, but it is only now reaching the cutting stage on most of the plantations, and where it has been longer established there unfortunately does not seem to have been much observation bestowed upon its nature or the circumstances of its growth.

You can easily perceive the necessity we are under of obtaining a clear understanding on the points raised in this letter, as, for instance, when it will be advisable to reset the fields with young plants so as to be ready to take the place of the old ones as the latter die off, and also how to prolong the life and increase the yield as much as possible. I need not say how thankfully any assistance you may kindly give in this direction will be received.

Yours very obediently,

The Director, (Signed) J. GURDON.
Royal Gardens, Kew.

ROYAL GARDENS, KEW, to Mr. AUSTEN CHAMBERLAIN, M.P.

Royal Gardens, Kew.

DEAR MR. CHAMBERLAIN, August 18, 1893.

WHEN your brother was last at Kew he left with me a memorandum respecting the age at which plants of the Yaxci of Yucatan, now known as the "Bahamas Pita" or Sisal, reach their maturity. He also asked whether anything could be done by processes of cultivation to retard the poling or the appearance of the flowering panicle, which, it is well known, marks the duration of the life of the plant.

2. There is apparently very little reliable information obtainable in regard to the age at which these plants flower. In fact in the whole of the literature of the subject the references are very few and the language is vague and inconclusive. In the enclosed memorandum I have given a brief summary of what has been recently published, and it may be possible to draw some general conclusions from the facts therein stated.

3. The observations in regard to the Sacqui of Yucatan do not, it is true, bear directly upon the subject. But as the Yaxci or Bahamas Pita is only a variety of the same species it is improbable it should differ in any marked degree from that plant. The length of time that elapses previous to flowering in Agave plants may in some degree be affected by soil and climate, but as a general process of growth and with plants cultivated normally over a large area the experience in Yucatan may not be far from what will ultimately obtain in the Bahamas.

4. The latest information from Yucatan is furnished by Mr. Pierce, the Vice-Consul at Merida. He states that "a Hemp plantation in "Yucatan lasts for some 15 years." This is not conclusive as regards the age of the individual plants. It merely shows that while some of the original plants may pole at one age and some at another, their places are so filled up from time to time by new plants that the whole undertaking receives no serious check up to about the fifteenth year.

5. It appears to be recognised in Yucatan as the result of experience (without apparently any reference to the determining causes) that poling is encouraged amongst these plants if the leaves are left uncut for any length of time after they have arrived at maturity. There is little or no scientific basis for this opinion, and experience at the Bahamas should be carefully recorded if tending in that direction.

6. They also believe in Yucatan that if the root-suckers which are abundantly thrown out around the base are allowed to remain attached for a long period they tend to exhaust the parent plant and accelerate the period of poling. Such suckers no doubt divert the strength of the parent plant, and if allowed to remain too long either of two things must happen—the parent plant will produce fewer and smaller leaves or its period of maturity will be hastened. The practical outcome of this is the suggestion that such suckers as are necessary for supplying the plantation should be removed when large enough into nurseries and all others not required should be removed periodically and thrown away.

7. Mr. Stoddart, it is noticed, records that the Yucatan people are very particular when cutting the leaves to cut them as close as possible to the stem of the plant. In other words, they consider it undesirable to leave any portion of the base of the leaf to form what is called in tree-pruning a "snag" on the parent plant. A certain degree of "snag" is inevitable. This, however, afterwards falls off, when dry, leaving the central stem of the plant eventually quite clean. I am not prepared to attach much importance to this matter in relation to poling. It is undesirable as a matter of economy in fibre, and it may also have some effect on the general health of the plant. It certainly would produce an untidy appearance in the up-keep of the plantation, and altogether the practice of close cutting the leaves should be systematically carried out.

8. Coming now to the Sisal plant as known in Florida and the Bahamas, it is evident that an impression prevails both in Florida and the Bahamas that some of these plants have flowered at about the

seventh year after planting. The instances recorded are given in the accompanying memorandum. They are, however, not conclusive. The exact history of the suckers before they were put out, and the treatment they afterwards received in regard to cutting the leaves and allowing the suckers to remain on indefinitely, are not given. All these are important factors to be considered before an opinion can be formed. The result of further and wider experience will probably show that some plants may pole at seven years, others at a later period. It is unlikely, if properly treated, that they will all pole over a large plantation at the same time. If the plantation is carefully watched, and fresh plants are put in immediately the fact is realised, or at the first sign of poling, there need be little interference with the work of the plantation.

9. It is essential that fresh plants in large numbers be grown on in nurseries with the view of supplying any vacancies caused by poling. Also the pole should be cut out as soon as it appears above the leaves in order that the leaves already formed should be ripened before the plant dies. This practically means that the plant would be kept available for yielding fibre for nearly a year later than it otherwise would be.

10. There is another point to be briefly noticed. While it is important that all the mature leaves be cut when they have attained full development, great care should be taken that the immature leaves are not also cut. The regular cutting of the fully matured leaves might possibly tend, as mentioned above, to prolong the vegetative life of the plant and retard poling. Theoretically, however, there is no ground for such a supposition. On the other hand the cutting of immature leaves would certainly have a contrary effect. The plant would be likely to be weakened by the process, and the subsequent leaves borne by it would be smaller and weaker. The exact period when the leaves are to be cut should be carefully studied. As a general rule the leaves are ripening when they are gradually falling from the erect into the horizontal position on the plant. Also there may be some indication in the colour of the leaves. These are, however, matters to be decided on the spot by careful and skilful people. It is only necessary here to draw attention to them, and to state that both the life of the plants and the quality of the fibre, in other words, the success of the whole undertaking, may not improbably depend upon them.

I am, &c.
(Signed) D. Morris.

J. Austen Chamberlain, Esq., M.P.,
40, Prince's Gardens, S.W.

MEMORANDUM.

The Life of Sisal Hemp Plants.

There are numerous species of Agave (popularly called Aloes) belonging to the natural order *Amaryllideæ*. They are almost all monocarpic perennials. That is, they grow on for a number of years producing leaves only; finally they flower, and this they do but once in their life, and that period is apparently determined by the nature of their environment. Usually Agaves under cultivation in this country live to

a great age. On this account they are sometimes called century plants. In their native country they live for seven to 15 years. When once the monocarpic species have flowered and produced seeds or bulbils (pole plants) they die. The following notes refer to the Sacqui (*Agave rigida* var. *elongata*) and to the Yaxci or Bahamas Pita (*Agave rigida* var. *sisalana*) :—

(*a*.) Mr. Stoddart says, "the plant (the Sacqui of Yucatan) lasts " . . . for at least 25 years in a cutting state, depending on the soil " and treatment." To renew a plantation after the original plants have become exhausted, "it is usual to plant at proper distances, by the sides " of the old plants or between them, young shoots which three years " afterwards (and upon the failure of the old ones) will be fit for cutting." A new field will thus "be kept up without any loss of time or suspension of work." (Sisal Hemp, its adaptation to Jamaica, p. 4.)

(*b*.) Mr. Stoddart describes the poling as follows: "This happens when the plant has arrived at cutting age *and the plants are not cut*." . . . "When the pole begins to come out and gains a length of about " three or four feet, it is customary to cut it off close without injuring " the leaves. These leaves will then mature and be fit to be taken off " before the plant dies." (l.c. p. 7.)

(*c*.) Poling appears to be accelerated (1) by the leaves not being cut when they have arrived at maturity, (2) by the plants being exhausted by numerous suckers allowed to remain around their base, (3) by careless cutting of the leaves. Stoddart, on this latter point, says: "If the " stump (or base) of the leaf be left of any length on the trunk it " seriously injures the plant, spoils its vigour, and *makes its existence a* " *short one*." (l.c. p. 7.)

(*d*.) Mr. Pierce says: "A hemp plantation in Yucatan lasts for some " 15 years . . . on good land the crop commences in four years " or earlier, whilst on rocky ground from six years or more." (F. O. Report, 1892, p. 2.)

(*e*.) Mr. Dodge, discussing the Pita or Yaxci plant of Florida and Bahamas, remarks that in one instance, on very poor soil, he noticed that "a long row of plants set out 10 years ago to form a boundary " line had hardly made any growth." (Report of C. R. Dodge on "Fibre Investigation in the United States." Washington, 1893, p. 21.)

Mr. C. T. McCarty of Ankona, Florida, says: "With us *Agave sisa-* " *lana* sends up its pole at seven years on our best lands. . . . So " far as the plant is concerned the 'poor land' theory has no foundation " in this locality. Our strongest and finest plants are on our best land." (Dodge, l.c p. 15.)

(*f*.) Mr. Merrick Shaw, Polk County, Florida, describes a Sisal Hemp plant under his observation as follows: "The original plant growing on " the soil, of which a sample was sent, poled at seven years old. Twenty " layers of leaves had been cut from this plant, and the lowest of those " remaining measured 5 feet 9 inches in length by 5 inches in width at " the broadest part. About 100 suckers had been removed from (the " base of) this plant and planted elsewhere." (Dodge, l.c. p. 17.)

(*g*.) Mr. Dodge figures and describes a plant with leaves barely a foot " long, which had thrown up a slender pole to a height of 8 feet or " more." He adds: "I was informed by residents on Indian Key " that this premature blossoming of a young plant or sucker *while* " *yet attached to the parent root* is not of uncommon occurrence." (Dodge, l.c. p. 18.)

Kew, 16 August 1893. D. M.

[*Note added.*—The plant cultivated in Mauritius, and yielding what is known as Mauritius Hemp is the Green or Fœtid Aloe (*Furcræa gigantea*). The value of the exports are about 50,000*l.* annually. This plant is similar to an *Agave*, both in appearance and habit, and it also produces numerous bulbils or pole-plants after flowering. The experience in Mauritius with regard to poling of the *Furcræa* has a striking resemblance to what has been observed in regard to the Agave in Yucatan. M. de Chazal, who has written an account of "*Le fibre d'Aloës*" (Mauritius, 1882) states (p. 21) "that "the plants generally pole at the age of seven or eight years; they can, "therefore, be cut four or five times before poling and before it is "necessary to replace them." On the same subject Mr. John Horne, F.L.S., late Director of Gardens and Forests in Mauritius, writes under date of 4th September 1893, as follows: "The life of *Furcræa gigantea* "in Mauritius is from seven to 10 years . . . as many of the plants "flower three to four years earlier than others, the leaves of the seedlings "(or pole-plants) from these are fit for cutting when the late flowering "plants are dying out, so cutting once begun on a plantation may be said "to be continuous. . . . . Supplying amongst old plants should be "done in time so that as the old ones die out cutting from the young ones "should begin. Over-cutting the leaves is common in Mauritius. This "is generally held to be injurious to the plants, weakening their growth "and causing them to flower and die prematurely. People in Mauritius "say that by cutting only the mature leaves the growth of the plants is "not weakened, and thus large fine leaves are obtained, yielding long fibre "of the finest quality. But I have never heard the idea expressed that "such a manner of cutting prolonged the life of the plant beyond what "I might call the natural limits. It is said in Mauritius that over-cutting "weakens the plants and causes them to flower and die prematurely, so "it may be also said in Yucatan that cutting only the mature leaves pro-"longs the life of the plants to its natural limits. It comes to this, that "what is said not to shorten the life of the plants in Mauritius is said to "lengthen it in Yucatan—a case of arriving at the same place from "opposite directions."]

CCCXXXVIII.—COFFEE CULTIVATION IN THE NEW WORLD.

In the year 1874–75 Ceylon exported 988,328 cwts. of coffee, or a little under one million cwts. In the year 1892 the total exports were only 43,143 cwts., or less than one-twentieth of the exports of 1874–75. In fact, it may be said that the splendid coffee industry of Ceylon has within the last 20 years almost ceased to exist. This, as is well known, has happened owing to the appearance of a deadly fungoid disease amongst the coffee plants, rendering them incapable of producing remunerative crops. This disease (*Hemileia vastatrix*) is known as the "Ceylon coffee-leaf disease." It has extended its ravages into nearly every coffee producing country in the Old World. It first of all spread from Ceylon to Southern India and then gradually extended itself to the rich coffee plantations of Java, to Sumatra, the Straits Settlements, Mauritius, Natal, Madagascar, and last of all to Fiji. The effects of the disease have been almost as deadly in other countries as in Ceylon. Hence in the Old World tropics coffee cultivation is carried on under

very disadvantageous circumstances, and the total yield is comparatively small. Fortunately, the disease has not, as yet, appeared in any portion of tropical America, either in the West India Islands, in Central America or tropical South America. The falling off in the production of coffee in the Old World has naturally produced a stimulating effect upon coffee cultivation in the New World. Prices have ruled high and the industry has, on the whole, proved of a very remunerative character. The important coffee industries in Guatemala, Costa Rica, and Brazil have greatly contributed to keep up the supplies in the world's markets, and as might naturally be expected they have in consequence become singularly prosperous. In Guatemala especially the exports during the last few years have nearly doubled, and they are now of the annual value of nearly three millions sterling.

Attention was called to coffee production in Guatemala in the *Kew Bulletin* for November last (1892, p. 23). It was then sought to call into existence a similar industry in the rich lands of the adjoining Colony of British Honduras. Everything necessary for such an industry could be made available in British Honduras, and the fact that one estate has already been established there, shows that the soil and climate are favourable to the production of excellent coffee. It is probable that before long sufficient capital and enterprise will be forthcoming to bring to this British Colony some of the prosperity which is now so much in evidence within a few miles over its frontiers. Jamaica is an old coffee-producing country, and some of its produce from the Blue Mountains ranks as nearly the best in the world. Of late years, however, there has been little or no increase in the exports of Jamaica coffee. In fact what change has taken place has been for the worse and not for the better. In 1882 the exports (according to the *Handbook of Jamaica*) were 41,004 cwts.; in 1892 they had fallen to 25,677 cwts. There are yearly fluctuations depending upon seasons and prices, but the general tendency lately, in spite of good prices, has been towards a smaller production of Jamaica coffee. At a first glance this may have been attributable to a gradual exhaustion of the present estates and to a want of suitable land for opening up new estates. It is true that some of the old estates are becoming less productive than formerly, but there are still excellent tracts of land suitable for coffee cultivation in Jamaica, and these only require to be rendered accessible by railways and roads to support a considerable industry. As may be gathered from the correspondence below, it appears that not only are no new coffee plantations opened in suitable lands in Jamaica, but the labour that might be employed upon them is being attracted from the island for service on the coffee plantations of Guatemala.

The forest lands still remaining in the interior of Jamaica require to be carefully protected in certain localities, but after all reasonable precaution is taken in the interest of forest conservation there is room for numerous flourishing coffee estates in the island, and now, when so much is done in other countries in the New World in regard to coffee cultivation, it would be singular if little or nothing were done in British Colonies possessing equal, or, in some cases superior, advantages.

ROYAL GARDENS, KEW, to COLONIAL OFFICE.

SIR, Royal Gardens, Kew, July 15, 1893.

I AM desired by Mr. Thiselton-Dyer to inform you that the remarkable development of the coffee industry in the Republic of

Guatemala was noticed in the *Kew Bulletin* for November last, and attention was directed to the very favourable prospects which the cultivation of coffee offered to suitable men in the adjoining Colony of British Honduras.

2. In a Report just issued by the Foreign Office (No. 1245 Annual Series, 1893), there are further interesting facts given in regard to coffee cultivation in Guatemala, and these concern very intimately the important Colony of Jamaica.

3. It appears that an effort has been made to supply the deficiency of labour in Guatemala by importing free Coolies from Jamaica. The Report states that "a comparatively small number of coolies have been "brought from Jamaica by an American firm of coffee planters, and are "found to do extremely well. This is the first time foreign labour has "been managed with success, and may indicate the direction in which "to look for a possible solution of the problem."

4. These coolies are time-expired immigrants whose movements cannot be controlled by the Jamaica Government. They have, however, cost the community large sums of money, and after having been brought all the way from India and taught plantation work it is a disheartening circumstance that they should be attracted out of the Island.

5. This is all the more to be regretted as there are at the present time thousands of acres of valuable land in Jamaica as well adapted for coffee cultivation as any portions of Guatemala. In a lecture delivered before the Institute of Jamaica on the 17th May, 1881, with the late Hon. Alan Ker, Senior Puisne Judge, in the chair, I stated:—"With "regard to amount of land still available in the Island for coffee cultiva- "tion, reports from Manchester and St. Ann show that there are "thousands of acres of good coffee lands at elevations between 2,000 "and 2,500 feet in the Mile Gully mountains, and on through Clarendon "and St. Ann, which might be very advantageously brought under "cultivation. In the Blue Mountains districts and on the southern "slopes there are not many tracts unopened, but on the northern "slopes there are extensive areas finer and richer than any now "cultivated lying in the upper portions of the valleys of the Rio Grande, "Swift and Spanish Rivers. These tracts are estimated at from 60,000 "to 100,000 acres and consist almost entirely of untouched virgin "forest."

6. These lands require to be opened up by railways and roads, and as regards the former a good deal has already been done by the enterprise of the Jamaica Government in that direction. If the Government could see its way to open roads from the railways into some of the lands above mentioned and offer them for sale after making their existence thoroughly well known in the United States and in Europe, it is probable that successful new coffee plantations could be established in Jamaica worked by the labour which is just now being attracted elsewhere.

7. In spite of the great difficulties experienced in Guatemala with regard to labour, it is noticed, that the production of coffee has risen from 49 million pounds in 1888, to 75 million pounds in 1892. Of the latter quantity more than eight million pounds, of the value of 322,000*l.*, have been received in the United Kingdom. These facts are of considerable importance to Jamaica, and Mr. Thiselton-Dyer is of opinion that the Government of that island would do well at the present time to encourage in every possible way the development of so important an industry. It is one well understood amongst all classes of the community and thoroughly adapted to the soil and climate of districts

that only require to be made accessible to render them the richest of any in the Colony.

I have, &c.
(Signed) D. Morris,
Assistant Director.

Edward Wingfield, Esq., C.B.,
Colonial Office, S.W.

Foreign Office Report. Annual Series, 1893, No. 1245, Guatemala.

(Extracts.)

On some plantations, to meet these increasing difficulties, South Sea Islanders have been imported, but owing to difference of climate, food, language, and perhaps more especially because their employers have no experience in dealing with these people, the venture has not proved successful.

On the other hand, a comparatively small number of coolies have been brought from Jamaica by an American firm of coffee planters, and are found to do extremely well. This is the first time foreign labour has been managed with success, and may indicate the direction in which to look for a possible solution of the problem . . . .

The growth of the coffee industry during the last 5 years has been as follows, viz. :—

Table H.

Year.	Crop.	Excess over previous year.	Value.
	lbs.	lbs.	£
1888 - -	48,743,024	203,757	2,003,734
1889 - -	51,571,939	2,828,919	2,119,162
1890 - -	51,973,414	401,475	2,135,743
1891 - -	52,197,853	224,439	2,185,397
1892 - -	74,652,985	22,455,132	2,714,644

Note.—These values are calculated at the rate of 4*l.* to the quintal of 100 lbs. on board.

The apparently small increase in value (529,247*l.*) as compared with the increase in production (22,455,132 lbs.) in the crop of 1892 is due principally to the depreciation in the value of the dollar.

The exportation of coffee has been as follows, viz. :—

Table I.

Country.	Quantity.	Value.
	lbs.	£
Germany - - - -	23,075,027	923,001
United States - - - -	16,843,903	663,756
England - - - -	8,049,724	321,988
France - - - -	3,305,975	132,239
Austria - - - -	303,953	12,158
South America - - -	179,933	7,197
Italy - - - - -	43,030	1,721

The total number of coffee trees now standing is estimated to be 64,186,924, there being this year an increase of 25,138,994.

Messrs. Lewis and Peat to Royal Gardens, Kew.

6, Mincing Lane, London, E.C.,

Dear Sir, August 28, 1893.

In reply to yours of 31st ultimo, we give you for what they are worth the following remarks on coffee.

After a period of comparatively low prices, the value of this product rose rapidly about six years ago, since when prices of the finer grades (plantation sorts) have remained fairly steady. We look upon the position of this particular kind of coffee, which is that which a European planter would aim at producing, as a strong one, the supplies from both Ceylon and East India having fallen off (in the former case they have almost entirely ceased), and their place being only very imperfectly filled by the finer coffees from Costa Rica, Guatemala, &c., especially Vera Paz and New Grenada. Among the British Colonies the West India Islands, or some of them, Trinidad, Dominica, and Jamaica, offer perhaps the best field for the cultivation of this product, the very serious drawback being possibly the difficulty in obtaining an adequate supply of labour. Fortunately the requirements in this respect are not so great with coffee as with some other products, as after the ground has once been cleared and planted the trees have only to be kept clean, pruned, and manured, when they will last for many years, giving, after the fifth year, their yearly crop of fruit, varying in quantity and quality according to the season and to the care bestowed on them. The number of hands required is, of course, much larger during crop time than during the rest of the year, but a good deal of the picking, &c. is done in many parts by women and children.

The machinery required for preparing the bean for market is not expensive, especially when there is sufficient water power available to work it, and no drying power beyond that of the sun is required for drying the produce. The climate in the higher parts of Jamaica is very pleasant, and suitable for Europeans to live in, and we understand that in the centre of the island there are large districts in which land very well suited to the cultivation of coffee may be obtained, though there is, we believe, this disadvantage, that *heavy* crops are not obtained in the very highest altitudes more than about once in three years. The difficulty, as we have said before, may be the securing a sufficient amount of reliable labour, but this is a difficulty common, we think, to almost every part of the globe, and, at the present time, to all industries. If this can be surmounted, as we doubt not it can be to a sufficient extent, with care and energy, we should consider that a young Englishman, with some knowledge of outdoor work, and with an inclination towards a planter's life, would have the prospect of a good future before him in coffee planting, supposing always that he is possessed of sufficient capital to buy, clear, and plant his land, and to keep his estate going for the four or five years before payable crops can be harvested, without having to borrow for the purpose at a heavy rate of interest.

The statistical position you have doubtless already before you. Notwithstanding the increased crops from Brazil during the past few years as compared with the previous production from that place, there has been little or no accumulation of stock at the consuming centres of the world, while dealers in the finest descriptions find frequently considerable difficulty in satisfying their requirements.

Always at your service,

We are, &c.

D. Morris, Esq., C.M.G., (Signed) Lewis and Peat.
Royal Gardens, Kew.

CCCXXXIX.—RESOURCES OF BRITISH HONDURAS.

A very exhaustive Report on the present condition of the Colony of British Honduras, prepared by the Governor, His Excellency Sir Alfred Moloney, K.C.M.G., has recently been issued by the Colonial Office (*Colonial Office Reports:* Annual, No. 73, 1993). From this Report the following general survey of the resources of the Colony will prove of interest not only in this country, but in many portions of Her Majesty's Possessions.

The commercial prosperity of colonies which depend on a limited number of articles of export is liable to disastrous fluctuations. Striking instances are to be found in the ruin of a once extensive trade, that had been confined to a single commodity, from competition and the inevitable fall in price, from the ravages of rats or locusts, or from a single blight. So far British Honduras would seem to have stood exceptionally in the Colonial Empire in having for the past two centuries relied almost entirely upon its forest produce and on its rivers as means of transport to the sea. Some of our West African Possessions have stood somewhat similarly since palm oil succeeded the slave export trade; that industry is now seriously threatened by animal fats and other sufficiently available and equally suitable commodities. One of the extracts from coal tar practically killed the once flourishing and profitable cochineal trade, and also affected the indigo trade of India. Beet has contributed to the depression of the sugar trade. The substitution of iron for wood in shipbuilding, particularly in men-of-war, at one time almost killed the large timber export trade of the Gambia and West Africa. These are again attracting attention for their mahogany, cedar, rosewood, dye and other woods; and the marked and progressive revival of the trade, and the dimensions it is assuming must naturally be a subject of direct concern and anxiety to all wood-cutting centres.

Mahogany and logwood trees have been for several generations the principal articles of commerce in British Honduras, but they are said to be getting more and more difficult of access and consequently more expensive to work and get to the market. The value of these industries is not for one moment questioned. On the contrary, it is highly desirable to promote them and to protect the forests on which they depend. The Colony's motto, "Sub umbra flores," should have now a more extended application.

In view, however, of such experiences as have been referred to, it has been generally accepted that even in commerce it is a hazardous experiment to "carry all your eggs in one basket."

As guides in establishing profitable industries we must look to the source of supply, the prospects and disposal of growth, and the area of the field of demand. It has now become a generally accepted policy in the Colonies to encourage the production of varied staple articles of export of a more or less permanent character. Much has been done in this direction by the active interest and assistance of the authorities of the Royal Gardens at Kew to develop new industries and to distribute plants of commercial importance. With this object there have been established in all our West Indian Possessions Botanic Stations. A similar institution has been established as a tentative measure in Belize, the capital of this Colony, which has such exceptional advantages whether we look to climate, soil, or a market. It has with some justice been advanced that British Honduras can be made the tropical garden

of North America, and it may be remembered that 28° North is generally accepted as the frost line, which may be said to mark the limit northwards within which the growth of economic products in demand can be profitably undertaken.

Fertility of Soil.

As to fertility of soil, what more convincing proof can be advanced than the facts that in the sugar areas to the north and south of the Colony cane has been known to "ratoon" from 20 to 30 years, and that in the rich and naturally fertilised valley beds, bananas have maintained themselves without degeneration for 10 to 12 years, if not longer.

Products.

The products of cultural industries, still really in their infancy, are chiefly bananas, plantains, cocoanuts, coffee, henequen, Indian corn, limes, mangoes, sour and sweet oranges, pineapples, avocado pears, rubber, to which there should be added in time annatto, cacao, coir, ground-nut, indigo, jute, pita, ramie, spices, vanilla and doubtless other promising marketable commodities.

To the small extent to which the banana has been successful to the north of the frost line referred to, where it will always be a precarious crop at best, it has proved inferior in quality to the West Indian and Central American fruit. Whilst in 1879 it did not appear among our records its export was represented by 72,436 bunches in 1891.

The plantain is a staple of food over a large section of Negroland in West Africa. The descendants of its interesting people to the north of the Gulf of Mexico represent a consuming power of probably 9,000,000. Tons of this fruit from Cuba and elsewhere meet with a ready sale in Florida. This Colony's shipments to New Orleans rose from 50,000 plantains in 1879 to 1,580,200 in 1891.

Cacao.

The home of the cacao is in tropical America. One or more valuable species may belong to British Honduras and include that which is said to be the best in a marketable sense. Notwithstanding, it may be said to be here remarkable for its absence from the export cultures of the Colony which have grown in value, in round numbers, from $12,000 in 1879 to $296,665 in 1891. Yet, in the island of Grenada, of the West Indies, and but 5° to 6° to our south, and with an area of 133 square miles and an estimated population in 1889 of 50,000, cacao has developed into its main export, which reached in 1890 a value of 228,319*l.*

Ground-nut and Vanilla.

The clover-like ground-nut, so desirable as a pasture where the bread-nut is not available, apart from its valuable oil-yielding seed, and henequen would seem to be admirably suited for growth in the pine ridges, as would also the Ceara rubber. That interesting orchid, the vanilla, whose home is also in Central America, is one of the most valuable products and has, near at hand, a rich and ever-growing market. Its cured pod sometimes fetches as much as 30*s.* per lb. It is a plant easily propagated by means of cuttings, and has developed into a considerable export from Vera Cruz.

Coffee.

Our Guatemalan neighbours seem to turn no small attention to the cultivation of the Arabian coffee. Whilst it will doubtless prove suitable to the high areas of the Colony, the introduction of the hardy and rich Liberian coffee—so well suited to low-lying areas, with its comparatively heavier crop, averaging from 6 lbs. to 8 lbs. per tree, 400 of which can be accommodated on each acre—should receive the consideration it deserves. Judging from the exports from the Malay Peninsula, and the imports to the United States, there is a promising field of demand offered in the direction of the latter for the growth of Liberian coffee and of such commodities as jute and other fibres, indigo, ginger, and spices generally.

Cohune Oil.

The Cohune oil industry remains yet dormant, if I except the use for domestic and cooking purposes to which it is put among the families of mahogany and logwood cutters. Two-fifths of the Colony, viz., 1,933,762 acres, are, it is estimated, under this graceful native "Prince of Wales" palm. If we allow 25 trees to the acre, a very low average, and 1,000 nuts as the annual yield per tree, and accept that 100 nuts yield a quart of oil, this dormant industry, if awakened to full activity, would yield 276,537 tons of oil at a price per ton appreciably above that which obtains for cocoanut oil, to which it is superior.

Pine Products.

Then, again, apart from its resinous property, which was turned, I understand, to profitable account some years back, the native pine is estimated to cover a third of the Colony, or, 1,613,136 acres, and to average 100 trees per acre on our great southern pine-ridge. Its wood is said to almost equal that of the yellow pine of the United States, which, in the beginning of 1888, was reported to have been nearly worked out and might, in part, have to be replaced by the local pine. The growth on the older pine-ridges of the Colony may, when opened up, prove of sufficient age and diameter to make it worth while to have attention turned to adding this timber to our exports, as can doubtless be done with many other valuable woods as yet unknown.

Cocoa-Nuts and Henequen.

The coral patches and marine islets we know as "Cays," that fringe to the eastward the waters of this Colony, offer a condition of site exceptionally favourable for the growth of henequen and the cocoanut tree, described as the most tender of palms as regards frost, the friend of tropical agriculturists. The area of such Cays is given approximately as 112,527 acres, which might be turned to much more profitable uses and yield than obtain at present. With even a quarter of such acreage suitable for the culture of such products as cocoanuts and henequen, it could be covered with plantations of the former numbering 2,813,200 trees with an annual yield of at least 100 nuts (a low average) aggregating 281,320,000, worth, at the current rate per thousand, 1,406,600*l.*, I might explain that such an aggregate of nuts on the basis of 1 lb. from 7 nuts or 14 per cent. fibre, should yield 18,000 tons of fibre that would realise in the London markets from 30*l.* to 10*l.* per ton, according as it is suited for brushes, mats, or stuffing.

The annual export from the Colony of cocoanuts during the past five years has averaged in number 1,651,933, and in value $32,505.

Sapodilla and Pimento.

That delicious fruit, the sapodilla, if picked green, will stand shipment; the tree abounds in this Colony, and apart from its valuable and durable wood, yields an extract which contributes mainly to the manufacture of what is advertised and so widely used in the United States as "chewing gum."

Then, again, trees yielding the pimento of commerce abound in a wild and unappreciated state, yet this spice was exported from Jamaica to the value of 81,326*l.* in the year 1890–1.

CCCXL.—THE PRIETO FIBRE EXTRACTING MACHINE.

In Captain Jerome Stuart's report on the fibre industry of Yucatan, reproduced in the *Kew Bulletin*, 1892, p. 272, mention was made of certain machines that were being tried for the purpose of extracting fibre from the leaves of the Sisal Hemp plant or Henequen. An account of one of these machines, known as the Weicher Fibre Extracting Machine, now on trial in this country, was given in the *Kew Bulletin* for June last (1893, p. 141). Another machine mentioned was the Prieto machine. Of this Captain Jerome Stuart gave the following brief particulars:—"The Prieto machine is manufactured by Puig and "Negre, Barcelona, Spain. It requires 16-horse power engine and "the services of two men and a boy. Capacity, 7,000 pounds "of dry fibre per day of 10 hours. Cost, 4,500 dollars." As the value of a machine depends so entirely on its capacity, it was desirable to obtain more precise information on this point. In the following letter received from the makers of this machine, it will be noticed that they claim that the machine will clean 100,000 leaves, and turn out from 5,833 to 5,960 pounds of dry fibre per day. These estimates of capacity prove how untrustworthy any figures must be that are not based on actual trial. In fact, it is impossible to attach any value whatever to such figures unless they are checked by some one having a thorough knowledge of the subject and perfectly unbiassed in his judgment:—

[Translation.]

Señor Roman Romano to Royal Gardens, Kew.

Calle Fontanella 10, Barcelona,
12th November 1892.

Dear Sir,

Messrs. Puig and Negre have sent us the printed report by Captain E. Jerome Stuart, of the Bahamas, as well as your favour of the 2nd instant.

These gentlemen were the first makers of our machines for extracting fibre of Sisal and Henequen, but afterwards we set up in this city our works for making them, having already sent about 40 machines, "Prieto Hermanos" system, to the State of Merida de Yucatan (Mexico), where they are working perfectly with favourable results for the farmers who purchased them.

We have no photographs or drawings to send to you, but we forward an account of the work it does compared to the old grating wheels, power required, and price of the machine here for cash.

Hoping that this information will be useful to you for the Henequen plantations in the Bahamas,

I remain, &c.
(for Romano Noriega y Preto)
D. Morris, Esq., F.L.S. Roman Romano.

Comparative Statement of the difference between 12 of the present Scraping Wheels (Raspadoras) and the La Vencedora Machine, system "Prieto Hermanos."

People employed in 10 hours' work.

La Vencedora.	12 *Raspadoras.*
1 for the feeder.	20 scrapers (men).
2 „ carrying leaves.	7 carriers of leaves.
1 „ receiving the fibre.	
2 „ carrying it to drying room.	4 people to carry to drying room.
2 „ collecting the waste.	7 „ to collect waste.
8 total people employed.	38 total people employed.

The difference in favour of the La Vencedora machine is therefore 30 men.

Production of Fibre.

La Vencedora.	12 *Raspadoras.*
100,000 leaves scraped in the machine give from 230 to 235 arrobas (5,833 to 5,960 lbs.).	100,000 leaves scraped in 12 raspadoras give from 165 to 170 arrobas (4,185 to 4,311 lbs.).

Difference in favour of the La Vencedora machine equals 65 arrobas (1,648 lbs.) increase per day. Cash price for machine in Barcelona, 4,500 Spanish dollars (928*l.* 2*s.* 6*d.*). Power, 12 to 16 horse power (steam). Water is not required to wash the leaves. Total weight of the machine, 9,500 kilogrammes (9 tons 7 cwts.).

(Signed) Roman Romano,
Barcelona.

CCCXLI.—ARROWROOT.

Arrowroot is a name properly confined to the starch extracted from the rhizomes of *Maranta arundinacea*, a plant indigenous to the West Indies. It is said to have first been discovered in Dominica, hence sent to Barbados, and subsequently to Jamaica. Arrowroot is said to have first been introduced into England in 1732, but the first actual consignment in quantity is put as late as 1799.

St. Vincent Arrowroot had for many years a high reputation, which of late it has somewhat lost. A full account of its preparation is given in the *Kew Bulletin* for August of the present year (pp. 191–204).

Arrowroot from Granada has lately come into the market, and some particulars on the subject are given below.

Inquiries were addressed to Kew as long ago as 1878 on the subject of Arrowroot in Queensland.

Its production from *Maranta arundinacea* seems to have presented some difficulties, and those of *Tous les mois* (also originally a West Indian product) from *Canna edulis* seems to have taken its place. This, if not identical with Arrowroot, has its own merits. Some information on the subject is given below.

South Sea Arrowroot is the produce of *Tacca pinnatifida* (*Kew Bulletin*, 1882, p. 51), plants of which flowered at Kew in 1891, and were figured in the *Botanical Magazine* (tabb. 7299, 7300). In the letter-press Sir Joseph Hooker gives an interesting historical discussion of the discovery of the plant and its uses.

QUEENSLAND.

Mr. H. L. Thompson in "Pharmaceutical Journal," October 22, 1892.

The Arrowroot Plantations of Coomera and Pimpama, Queensland.

The arrowroot grown in this district is the purple variety, the *Canna edulis*. It sometimes grows to a height of eight feet, bears a pretty scarlet flower, and a dark purple seed-pod follows, which is generally sterile. The best variety of arrowroot, the *Maranta arundincea*, which is grown so extensively in the Bermudas, thrives well in this district; but its cultivation has been almost abandoned, owing to the difficulty of manufacture. This kind attains the height of two feet, and bears, at maturity, a small white flower somewhat resembling the potato blossom. In the districts of Coomera and Pimpana there are from 250 to 300 acres under cultivation.

Mr. George E. Moore to Royal Gardens, Kew.

1, Jeffrey's Square, St. Mary's Axe, E.C.,
June 17, 1893.

Dear Sir,

By the mail the following inquiry was made in reference to a sample of Queensland arrowroot which I sent to St. Vincent to a correspondent to show him what was being done:—"Obliged to you "for sample of arrowroot. Is this *Tacca pinnatifida* or South Sea "arrowroot? I am very interested to obtain the latter." Can you answer this question for me? I enclose a small sample of Queensland arrowroot which please do not trouble to return.

I also enclose a copy of a letter, with editor's note, that appeared in a trade journal which appears to answer my question, if you consider the explanation therein given correct. It is certainly correct that "Tous les mois" when imported from the West Indies as that, does [not] fetch so high price as their arrowroot.

I am, &c.
(Signed) Geo. E. Moore.

Extract from "Produce Markets Review," 10th June 1893.

Dear Sir,

The *Brisbane Courier* of April 15 contains a paragraph copied from your journal (no date given) derogatory to Queensland arrowroot. The quotation concludes, "It is much inferior in point of "strength and glutinous properties as compared with St. Vincent "arrowroot."

Being the manufacturers and shippers of this parcel under notice, we challenge this assertion, and are quite prepared to submit our production to a public test in competition with the other makes named.

That there is a slight difference we admit, ours being made from a different plant, viz., *Canna edulis;* but when prepared as directed cannot be distinguished. Certainly the slight difference in texture does not warrant the extreme prejudice that seems to exist in certain quarters against Queensland production.

We remain, &c.
Pimpama, April 21. F. Lahey & Sons.

[Arrowroot was originally only prepared from the root of *Maranta arundinacea.* The term has since by common commercial usage been extended to similar starches extracted from other plants, though Dr. Hassall, in his work on adulteration, thinks the practice undesirable. The starch of the *Canna edulis* was known to commerce as "Tous les mois," and did not fetch nearly so much as St. Vincent or Natal arrowroot. Messrs. Lahey's produce is evidently from its better colour an improved preparation from *Canna edulis*, but the price it fetched at public sale is the best guide as compared with St. Vincent and Natal. No doubt the *Maranta* could be readily grown in Queensland as the *Canna*, and these preferences for particular tints of colour or strength of gluten are, more or less, a matter of habit, and possibly not very reliable. The preparation is quite a legitimate one in every way, and it is a question for Messrs. Lahey whether the price is satisfactory, but if not they might try other plants. If called "*Canna*" arrowroot, there could be no misconception, and it might in time attract a special connexion of its own.—Editor, *P. M. P.*]

Messrs. Low, Sons, & Bedford to Royal Gardens, Kew.

11, Billiter Square, London, E.C.,
Dear Sir, December 13, 1893.

Having noticed your name in one of the trade journals in connexion with an article on arrowroot, we have taken the liberty of sending you a sample of the Queensland product (*Canna edulis*) prepared by our friends, Messrs. F. Lahey & Sons, of Pimpama, Queensland, who are doing all they possibly can to improve their production and bring it to perfection. They have recently planted another sort of arrowroot, the *Maranta arundinacea*, a shipment of which we expect to arrive in this country very shortly.

If you could favour us with any information especially as to modes and machinery in use in other places, the same would be esteemed.

Yours faithfully,

W. T. Thiselton-Dyer, Esq., Low, Sons, & Bedford.
Royal Gardens, Kew.

GRENADA.

Curator, Botanical Station, Grenada, to Royal Gardens, Kew.

Botanical Station, Grenada,
June 15, 1893.

Dear Sir,

I send by this mail two samples of arrowroot prepared by Mr. Minors, of Bacolet Estate in this Island.

It is quite a new industry here, and Mr. Minors is most energetic in trying to make it a success. He is also very anxious to find out if the sample dried by artificial heat comes up to the standard of good quality, and has asked me to forward them to you, and solicit your kind assistance in obtaining a report on them.

I am, &c.

D. Morris, Esq., F.L.S., (Signed) G. W. Smith.
Royal Gardens, Kew.

Messrs. W. and D. Harvest to Royal Gardens, Kew.

Dowgate Dock, Upper Thames Street,
London, E.C., July 3, 1893.

Dear Sir,

I am in receipt of yours of the 30th ultimo, with accompanying samples Grenada arrowroot. I have carefully examined these with the following results:—

Dried by heat.—Too floury, colour good, jelly opaque, but fairly strong.

Drid by air.—Well granulated and of good colour, jelly rather opaque, but not quite so firm as the heat dried.

The market value in Mincing Lane for the first would be about 3*d.*, and for the second sample about $3\frac{1}{8}d.$ for St. Vincent arrowroot of similar quality. Arrowroot produced in the other West India Islands not infrequently turns out less satisfactory than that from St. Vincent, and consequently they never command so good a price. Probably the above if offered in the usual way, viz., by public auction, would not command more than $2\frac{1}{2}d.$ per lb. The air-dried is decidedly the preferable of the two samples. My judgment is confirmed by one of the largest dealers in arrowroot in Mincing Lane. Singularly enough I find he has had the same inquiry addressed to him lately from Grenada, and I understood him to say has given a reply similar to my own.

I have always much pleasure in giving you any information in my power.

Yours faithfully,

J. R. Jackson, Esq., (Signed) D. R. Harvest.
Royal Gardens, Kew.

CCCXLII.—NEW ORCHIDS: DECADE 7.

61. **Pleurothallis maculata**, *Rolfe;* caule primario subrepente, secundario brevi, foliis ellipticis obtusis v. minutissime bidenticulatis valde carnosis, racemis brevibus pauci-multifloris, bracteis campanulato-tubulosis apice obliquis late triangulis subacutis, sepalo postico lineari-oblongo obtuso carnoso basi puberulo lateralibus connatis elliptico-ovatis carnosis puberulis apice bidentatis, petalis obovato-oblongis obtusis glabris, labello pandurato oblongo obtuso carnoso glabro, columna clavata alis carnosis.

Hab. Brazil.

Folia 1–1½ poll. longa, 6–9 lin. lata. *Racemi* ¾–1 poll. longi. *Bracteæ* 1–1½ lin. longæ. *Sepalum posticum* 4–5 lin. longum, *lateralia* paullo breviora. *Petala* 1½ lin. longa. *Labellum*, 1½ lin. longum.

A small species presented to Kew by Messrs. Shuttleworth, Carder, & Co., of Clapham, which flowered in September 1891, and again in the following July. It belongs to Lindley's section *Brachystachyæ*, and is allied to *P. recurva*, Lindl. The leaves are irregularly blotched and spotted with purple, in allusion to which the name is given. The dorsal sepal is light brownish purple above, much paler below, and the lateral ones crimson-purple. The petals are semipellucid white, and the lip purple.

62. **Pleurothallis unistriata**, *Rolfe;* herba dense cæspitosa minuta, foliis spathulatis, lamina elliptico-oblonga obtusa apice minutissime tridenticulata, scapis gracilibus, racemis pauci-multifloris, bracteis spathaceis basi infundibuliformi-tubulosis apice obliquis subobtusis, sepalo postico ovato-oblongo subacuto carinato concavo lateralibus angustioribus et planioribus liberis, petalis spathulatis obtusis, labello lineari-oblongo obtuso-trinervo, columna clavata.

Hab. not recorded.

Folia 9–12 lin. longa, 2–2½ lin. lata. *Scapi* 2–2½ poll. longi. *Bracteæ* ⅓ lin. longæ. *Pedicelli* 1 lin. longi. *Sepala* 1¼–1½ lin. longa. *Petala* ¾ lin. longa. *Labellum* ¾ lin. longum.

A very small species, belonging to the section *Apodæ cæspitosæ*, which has flowered in the Kew Collection on several occasions. It is very near the Guatemalan *P. marginata*, Lindl., which, however, has rather larger, more distant flowers, and the lateral sepals united to their middle. The flowers are semipellucid white; the petals each with a purple mid-nerve, and some similar colour on the lip. As the flowers become old, the colour diffuses itself through the petals and lip.

63. **Pleurothallis pergracilis**, *Rolfe;* herba dense cæspitosa, foliis spathulatis lamina elliptica obtusa valde carnosa, scapis gracilibus, racemis paucifloris, bracteis spathaceis basi infundibuliformi-tubulosis apice obliquis acutis, sepalo postico lanceolato-oblongo subacuto lateralibus fere ad apicem connatis elliptico-oblongis bidentatis, petalis lanceolatis acutis labello lineari truncato leviter bicarinato, columna clavata.

Hab. Belize, British Honduras.

Folia 6–10 lin. longa, 2½–4 lin. lata. *Scapi* 2–4 poll. longi. *Bracteæ* ⅓ lin. longa. *Pedicelli* 2 lin. longi. *Sepala* 2 lin. longa. *Petala* ¾ lin. longa. *Labellum* ¾ lin. longum.

This species has been cultivated at Kew since 1887, when it was received from the Belize Estate and Produce Company. It flowered in May 1892. It belongs to the section *Apodæ cæspitosæ*, and is allied

to the preceding species, from which it differs notably in size, its united lateral sepals, and the very different lip. The flowers are light yellowish white, with a purple mid-nerve to the petals.

64. **Scaphosepalum microdactylum**, *Rolfe;* herba dense cæspitosa, foliis oblanceolato oblongis apice tridenticulatis basi in petiolum attenuatis, scapis erectis gracilibus paucifloris, bracteis basi tubulosis apice triangulis acutis, sepalo postico oblongo basi valde concavo apice carnoso subobtuso lateralibus connatis apice liberis triangulatis breviter aristatis supra medium carnosis, petalis brevissime unguiculatis subobliquis ovatis acutis, labello unguiculato lineari-oblongo obtuso medio bilamellato lamellis denticulatis, columna clavata apice biangulata.

Hab. Not recorded.

Folia 1½–2¼ poll. longa, 3–4 lin. lata. *Scapi* 4–5 poll. longa. *Bracteæ* 1 lin. longæ. *Sepala* 3½ lin. longa. *Petala* 1 lin. longa. *Labellum* 1 lin. longum.

A singular little species, which flowered at Kew during 1890, and again in October of the present year. It is very distinct from every other, though perhaps nearest *S. ochthodes*, Pfitzer. The flowers are light greenish yellow except the upper half of the dorsal sepal, which is suffused with light purple-brown. It is characterised by the very short tails of the lateral sepals, scarcely half a line in length, in allusion to which the name is given.

65. **Masdevallia pusilla**, *Rolfe;* foliis lineari-lanceolatis minute tridenticulatis basi attenuatis, scapis ascendentibus flexuosis basi vaginis tubulosis involventibus, bracteis basi tubulosis apice triangulo-oblongis acutis, ovario exalato, sepalorum tubo campanulato pubescente lobis ovatis concavis caudis gracilibus, petalis lineari-oblongis apice carnosis carinato-angulatis papillosis crenulatis, labelli hypochilio utrinque angulato intus profunde sulcato epichilio saccato trilamellato, columna clavata, apice penicillato-fimbriata.

Hab. Not recorded.

Folia 4–6 poll. longa, 5–6 lin. lata. *Scapi* 3–4½ poll. longi. *Bracteæ* 3 lin. longæ. *Sepalorum tubus* 2 lin. longus, *caudæ* 4 lin. longæ, vix divaricatæ. *Petala* 1¼ lin. longa. *Labellum* 1¾ lin. longum.

This belongs to the section *Saccolabiatæ*, and is the smallest-flowered species of the group. It is readily distinguished from every other by this character, the less open tube of the sepals, and the nearly parallel or scarcely divaricate tails. It is perhaps nearest *M. troglodytes*, E. Morr. The sepals are pale yellowish green, densely spotted with dark purple-brown, and somewhat suffused with a lighter shade; the petals are yellowish white with a pair of large purple-brown blotches, and the lip has many light brown spots and some purplish lines near the base. The sac of the lip is unusually small. It flowered at Glasnevin in August 1891, and on subsequent occasions, when it was sent for determination by Mr. F. W. Moore, the Keeper of the Royal Botanic Gardens.

66. **Polystachya Buchanani**, *Rolfe;* herba cæspitosa, foliis lanceolato-oblongis subobtusis coriaceis basi conduplicatis, racemis paniculatis multifloris, rachibus puberulis, bracteis triangulari-subulatis recurvis, sepalo postico ovato obtuso v. apiculato lateralibus late triangulari-ovatis obtusis v. apiculatis, petalis spathulato-linearibus obtusis v. apiculatis, labello trilobo lobis lateralibus ovato-oblongis obtusis intermedio orbiculari-ovato apice reflexo, callo lineari-oblongo carnoso, disco farinaceo-pubescente, columna brevissima.

Hab. Zambesi district, E. tropical Africa.

Folia 4–7 poll. longa, $\frac{3}{4}$–$1\frac{1}{4}$ poll. lata. *Scapus* 8–12 poll. longus. *Rami* paniculæ 1–2 poll. longi. *Bracteæ* 1–$1\frac{1}{2}$ lin. longæ. *Pedicelli* 3 lin. longi. *Sepala* 2 lin. longa. *Petala* sepalis paullo breviora. *Labellum* 2 lin. longa.

This species bears much resemblance to *P. luteola*, Hook., from Tropical America, and *P. mauritiana*, Spreng., from the Mascarene Islands, and like them has light yellowish-green flowers with a faint trace of purple-brown near the margins of the sepals. It has been in cultivation for several years, having flowered in the Royal Botanic Garden, Glasnevin, in September 1889, and in succeeding years. It was sent from the Upper Zambesi district by Mr. John Buchanan to Mr. James O'Brien, Harrow-on-the-Hill, who has now sent it to Kew for determination. Among African species it may be compared with *P. rufinula*, Rchb. f., which has cinnamon-brown sepals, longer bracts, and larger flowers, though in habit and general character the two are nearly allied.

67. **Cyrtopera papillosa**, *Rolfe*; foliis linearibus v. lanceolato-linearibus acutis plicatis, scapis erectis elongatis apice racemosis multifloris, bracteis lanceolatis acuminatis, sepalis ovato-oblongis subacutis lateralibus pedi columnæ adnatis, petalis paullo minoribus, labello trilobo lobis lateralibus semiovatis obtusis intermedio suborbiculari truncato latere denticulato, disco ad medium bilamellato dein cristato-papilloso, calcare saccato brevissimo, columna brevissima.

Hab. Natal, *Sanderson*! open field at the Dargle; *Fannin*, n. 130! Inanda; *J. M. Wood*, n. 785!

Folia 9–12 poll. longa, 2–5 lin. lata. *Scapi* $1\frac{1}{2}$–2 ped. alti. *Racemi* 2–4 poll. longi. *Bracteæ* 5–8 lin. longi. *Sepala* 5–6 lin. longa. *Labellum* 4–5 lin. longum.

A very distinct *Cyrtopera*, comparable only with *C. foliosa*, Lindl. (*Hook. Comp. Bot. Mag.*, II. p. 203), collected by Drege in Kaffraria, between Basche and Omtata, which has three keels to the lip, a much smaller papillose disc, and various other differences. *C. papillosa* was collected by Sanderson as long ago as 1864, and has recently been imported by Mr. James O'Brien, of Harrow-on-the-Hill, from the same district. It flowered in the collection of Sir Trevor Lawrence, Bart., of Burford, Dorking, in August 1892, and, more recently, with the importer. The flowers are yellow, with the exception of the side lobes of the lip, which are purple-brown. The name is given in allusion to the numerous papillæ in front of the keels. The foot of the column is well developed, but the spur excessively short.

68. **Trichocentrum albiflorum**, *Rolfe*; herba nana, foliis ovatis v. ovato-ellipticis obtusis v. apiculatis, racemis brevissimis paucifloris heterochronicis, bracteis ovato-oblongis obtusis, sepalis petalisque obovato-oblongis obtusis, labello elliptico emarginato undulato basi subattenuato et obscure bicarinato calcare brevi apice bidentato, columna brevi latoque alis oblongis subacutis apice recurvis anthera pubescente.

Hab. Mexico; *Finck*.

Folia 1–$1\frac{1}{4}$ poll. longa, 7–8 lin. lata. *Racemi* foliis breviores. *Bracteæ* 2 lin. longæ. *Sepala et petala* 4–5 lin. longa. *Labellum* 6 lin. longum; *calcar* 1 lin. longus.

A curious little species sent to Kew in 1891, by Mr. Hugo Finck, of Cordova. It flowered in September 1892, and again during the present

year. It is allied to *T. candidum*, Lindl., from Guatemala, which is apparently the only other species in which the spur is reduced to a very short sac. *T. candidum*, however, has much longer leaves, and various differences of floral structure. In the present species the spur is distinctly bi-dentate. The flowers are white, with the exception of a purple stain at the junction of the lip with the column.

69. **Oncidium sanderianum**, *Rolfe;* pseudobulbis lineari-oblongis apice attenuatis subcompressis, racemis elongatis multifloris, bracteis convolutis oblongis obtusis, sepalis unguiculatis postico late cordato obtuso crispo-undulato lateralibus ovatis obtusis paullo undulatis, petalis late unguiculatis ovatis obtusis valde crispo undulatis apice complicatis annulato-cohærentibus, labello trilobo lobis lateralibus triangulis intermedio oblongo-ligulato obtuso, crista oblonga trilamellata apice tridentata lamellis crenulatis, columna oblonga basi latior alis falcato-linearibus.

Hab. Peru.

Pseudobulbi 3½–4 poll. longi. *Bracteæ* 6–7 lin. longæ. *Sepalum posticum* 1 poll. longum, lamina, 1 poll. lata; *lateralia* 1¾ poll. longa, lamina 10–11 lin lata. *Petala* 1 poll. longa, lamina 8–9 lin. lata. *Labellum* 8 lin. longum. *Columna* 3 lin. longa.

A handsome species of the section *Microchila*, allied to *O. annulare*, Rchb. f. and *O. monachicum*, Rchb. f., both of which have the peculiarity that the petals remain tightly clasped together at their much crisped tips, forming a ring. As regards its general appearance, it approaches the Venezuelan *O. falcipetalum*, Lindl., in which the petals are falcate and much crisped, though, according to ample dried specimens, they usually become free. The flowers are chocolate-brown, the dorsal one with a narrow yellow border. The petals are golden yellow broadly barred with brown, except at their tips. The lip is brown with a yellow crest, and nearly purple side lobes. Plants have recently been imported by Messrs. F. Sander & Co., of St. Albans, from Peru, together with dried specimens, from which this description has been prepared.

70. **Sobralia pumila**, *Rolfe;* herba dense cæspitosa nana, foliis ovato-lanceolatis acutis plicatis, bracteis similibus minoribus, floribus pedicellatis, pedicellis gracilibus, sepalis petalisque lineari-lanceolatis acutis, labello elliptico-oblongo apice fimbriato basi subattenuato disci venis fimbriato-cristatis, columna clavata.

Hab. Island of Marajo, Brazil; *E. S. Rand.*

Planta vix 6 poll. alta. *Folia* 2–3½ poll. longa, 6–10 lin. lata. *Pedicelli* 2 lin. longi. *Sepala* et *petala* 1 poll. longa. *Labellum* 10–11 lin. longum. *Columna* 6 lin. longa.

An unusually small plant for a *Sobralia*, of which a dried specimen has been sent for determination by E. S. Rand, Esquire, of Pará, Brazil. The plant is noted as "forming small tufts, the pseudobulbs "seldom exceeding 3 inches in height. Flowers bright canary yellow, "but very transient, lasting only a day; produced in profusion. Foliage "very dark green." It is allied to the New Granadan *S. fimbriata*, Lindl., which, however, is more than twice as tall, and has larger flowers borne on shorter pedicels. The veins of the lip are crested, but it is difficult to make out their exact details, owing to the difficulty of dissecting out such excessively membranous flowers when once dried.

CCCXLIII.—JARRAH TIMBER.

Eucalyptus marginata, Sm.

The following correspondence is supplementary to the particulars published in the *Kew Bulletin* for September 1890 (pp. 188–190), on the use of Jarrah timber for the purpose of paving the carriageways of public streets.

BOROUGH ENGINEER AND SURVEYOR, ST. PANCRAS, to ROYAL GARDENS, KEW.

Vestry Hall, Pancras Road, N.W.,
25th May 1893.

DEAR SIR,

WITH further reference to the subject of borings in Jarrah and Karri timber, I am sending you to-day two blocks of Karri and one of Jarrah, and also a piece of fir rail, which I came across a few days ago when in the country, which shows oval holes similar to those in the Australian timber, and perforating the wood promiscuously with regard to grain; in this timber I found grubs actually at work. Having in mind the fact that the particles of wood, in many cases filling the holes in the Australian wood without any compression, which would have taken place had the hole been originally circular and compressed to oval form by the process of the growth of the tree as you suggest, I am induced to form the conclusion that the borings have been made since the tree was felled. I think the less resistance offered to the action of the worm on lines approximately concentric to the rings of the tree is sufficient to explain the preponderance of holes in that position; but in the blocks sent you will find holes which vary somewhat from that course, and in the piece of fir you will notice how the whole of the surface immediately under the bark has been removed by the action of the grubs, which also penetrate the timber in varying directions, but again adopt a course which they found they could more readily pursue. In the Jarrah blocks I send, you will notice the holes are entirely different, being more of the nature of worm-eaten wood commonly found in our local timbers, particularly beech and oak, and which boring is undoubtedly done after the timber has been cut and often made up into furniture.

I had a copy sent me of a weekly paper, "Timber," dated May 20th, 1893, in which is printed a letter from Cathcart W. Methuen, Engineer-in-Chief to the Natal Harbour Board, in which he describes experiments made with Madagascar timbers as compared with samples of Australian Jarrah wood, and also greenheart, and he concludes by stating that the Jarrah, greenheart, and other timbers have all been more or less severely attacked by the worm, while the Madagascar timbers mentioned have been practically untouched.

I must thank you for the attention you have given in this matter and for your kind reply, in which you refer me to Mr. Maiden's book, which I shall certainly look at.

I am, &c.
(Signed) W. N. BLAIR,
Engineer and Surveyor

J. R. Jackson, Esq.,
Curator of Museums,
Royal Gardens, Kew.

Borough Engineer and Surveyor, St. Pancras, to Royal Gardens, Kew.

Vestry Hall, Pancras Road, N.W.,
September 2, 1893.

Dear Sir,

With reference to the matter on which we exchanged a few letters some months ago, viz., the boring in Karri wood, which we can now submit some further evidence on, for several insects have been found in the blocks, and I forward herewith a specimen unavoidably broken up somewhat seriously, but still it will be recognisable.

I have also a block in the office here with the insect in the hole undisturbed, and it is placed with its tail towards the termination of the hole, so that I conclude it did not crawl into the hole, but was hatched from the larva, and has not been able to move.

I shall be pleased to hear your views on the point, and only venture to trouble you because I know you will be interested, and so kindly offered to assist in discovering the cause of the holes in the woods.

Yours faithfully,
(Signed) W. N. Blair.

J. R. Jackson, Esq.,
Royal Gardens, Kew.

Mr. W. F. H. Blandford to Royal Gardens, Kew.

48, Wimpole Street, W.,
October 9, 1893.

Dear Sir,

The box forwarded to me, containing a piece of wood and a specimen of the insect attacking it, reached here before I got home at the end of my holidays. I would have written about it sooner, but have wanted to identify the species concerned, and have been too busy to pay a visit to South Kensington for the purpose.

But not to delay longer, I may say at once that the block has been bored by the larvæ of an exotic longicorn beetle belonging to the family *Prionidæ;* the workings of the larva have certainly been begun in the natural home of the tree, and probably while the tree was still standing. Of this I cannot be sure, for many *Longicornia* attack felled trees, laying their eggs in the bark, and, when this is the case, it is usual to remove felled timber as quickly as possible, or to bark it if it must be left lying for some time before deportation. I think, however, that it is more probable that the borings were not begun after the tree was felled. The only further injury that such wood is likely to incur after shipment is due to the completion of the larval burrows. The grubs are not readily killed *in situ*, but it may be done with a wire, but, as a rule, there is too much débris in the burrows to allow of either a wire or liquid reaching them.

The oval shape of the burrows is constantly that of the burrows of *Longicorn* grubs, and corresponds to the transverse section of the grub at its largest point. It would suffer no material change by the growth of the tree.

Nothing need be done in this country except to reject obviously unsound timber for road-making, though I should think that pieces slightly bored might be used, at least if the upper part were sound.

I will return the specimens soon, and I hope with the name.

Yours faithfully,
(Signed) W. F. H. Blandford.

CCCXLIV.—MISCELLANEOUS NOTES.

Mr. Carl Wilhelm Zimmer, a German member of the gardening staff of the Royal Gardens, was appointed (July) Foreman in the Botanical Garden, Munich.

Mr. Walter Haydon, a member of the gardening staff of the Royal Gardens, left Kew in September to undertake the duties of Acting Curator of the Botanic Station at Lagos during the absence on leave of the Curator, Mr. Henry Millen.

Mr. William Scott, formerly of the Royal Gardens and latterly Assistant to the Director of Forests and Botanical Gardens in Mauritius, has been appointed Director in succession to Mr. John Horne, F.L.S., retired.

The **Royal Scottish Arboricultural Society**, under the guidance of Colonel Bailey and Mr. Malcolm Dunn, of Dalkeith, visited the Royal Gardens, Kew, on August 12th, and inspected the principal objects of interest in the Gardens, Arboretum, and Museums. The party numbered 120, and included many of the leading Foresters and Gardeners of Scotland.

Aloe abyssinica, *var.* **laxiflora**, *Baker*.—A very distinct variety of this species is now flowering in No. 5. It differs from the type and from the variety *Peacockii* (figured in *Bot. Mag.*, t. 6620) by its unspotted bright green leaves, very long pedicels, and short reddish yellow flowers, with stamens not at all exserted.

A considerable number of new species of *Aloe* have been found lately by Dr. Schweinfurth in the mountains of Arabia and Abyssinia, which have not yet been introduced into cultivation.

Rhus cotinoides.—Several years ago we received at Kew seeds of this rare North American tree from Professor C. S. Sargent, of the Arnold Arboretum. For the first two or three winters the young shoots were badly injured by frost, and the plants had to be sheltered; since then, however, although the growth is not so vigorous as that of its nearest European relative, *Rhus Cotinus*, it seems to hold its own, and proves to be hardy at Kew. The autumnal tints assumed by the decaying leaves are especially brilliant, bright crimson and orange-red. The following particulars are extracted from Professor Sargent's magnificent work, "The Sylva of North America," where the species is figured under the name of Cotinus americanus:—*Rhus cotinoides* was first discovered by the Englishman Thomas Nuttall in 1819, on the banks of Grand River, a tributary of the Arkansas, within the present limits of Indian territory. Twenty-three years later it was found by Buckley in Alabama, where it grows in a few localities north of the Tennessee River, on the south slopes of the Cumberland Mountains, in the neighbourhood of

Huntsville. It also occurs on the Cheat Mountains, in Eastern Tennessee, and in the valley of the Medina River, in Western Texas. In its native habitats it attains a height of 25 to 35 feet, with a trunk 12 to 14 inches in diameter.

Robinia hispida, *Linn.*, **in fruit.**—This well-known shrub, which is a native of the Eastern United States, where it forms in some localities a considerable portion of the underbush, reproduces itself by means of suckers; its fruit being until quite recently almost unkown. Mr. Thomas Meehan, of Germantown, Philadelphia, who has studied the plant in its wild state on the Lookout Mountains, Tennessee, having made extensive inquiries as to the occurrence of seed vessels without success, concluded that, owing to the rapid production of suckers, the seed-producing power had been lost. At length he received two specimens, one of which he generously presented to Kew. The pod, which is rather more than two inches long and tipped by a short curved beak, is covered with weak brownish bristles about four lines long, and is slightly constricted between the seeds. Several pods mature on the same raceme.

Bamboo and **Arundo** from the **Shiré Highlands.**—Kew is indebted to the Right Hon. Lord de Saumarez, for plants of a Bamboo which is probably *Oxytenanthera abyssinica*, Munro, a widely distributed species in tropical Africa, and *Arundo madagascariensis*, both of them new additions to the Kew collection. His Lordship writes:—"I received them in 1889 from our Consul at Zomba, near Lake "Nyassa, Mr. John Buchanan. They are less hardy than I hoped, for "during the last winter the frost shrivelled up their leaves in an "unheated greenhouse, where I have hitherto kept them. I am afraid "it will be useless to try them out of doors even here."

Oxytenanthera abyssinica is described by Munro as having stems from 25 to 50 feet high, from 1½ to 3 inches in diameter at the base, and leaves 6 inches long by about an inch in width. He says:—"This fine "distinct looking bamboo seems to have a wide range in Africa, "extending into both tropics. Barter says that it was the only "arboreal grass he had seen (in Baikies' Niger Expedition), and that "the stems were used to pole canoes, and the smaller ones as shafts for "spears."

Arundo madagascariensis is a reed of very wide distribution in tropical and subtropical Asia and Africa, though originally only known to inhabit Madagascar. It grows from 10 to 20 feet high, and has relatively slender culms terminating in large feathery panicles similar to "pampas grass."

Duroline for **Wardian Cases.**—Duroline is a translucent, waterproof, pliable material, which is manufactured by the Wire Wove Roofing Company, 75, Queen Victoria Street, E.C., and is recommended and used as a substitute for glass for roofing large buildings, &c. It has for its basis a web of fine iron wire with warp and weft threads, and is covered with a thick translucent varnish. It is easily bent, can be cut with strong scissors, and is said to be weather and heat proof. Samples

of it were sent to Kew in October last by the manufacturers, inviting "attention to the special applicability of our patent unbreakable glazing "material, Duroline, for the glazing of Wardian cases, in which plants "are sent and received from abroad. We believe much damage and "annoyance results from the breakage of glass in these cases."

Six Wardian cases were, therefore, "glazed" with this material, and were despatched filled with plants to Ceylon, Australia, Jamaica, and Lagos during the summer. In every case they were favourably reported upon, and some of them have been returned to Kew filled with plants which reached us in good condition. The only drawback we have found in Duroline as a substitute for glass in Wardian cases is its stickiness inside after it has passed through the tropics, and the consequent glueing to it of the plants where they touch. This stickiness is due to the moisture and warmth inside the case. The manufacturers say "the "more Duroline is exposed to weather the harder it becomes." On the whole, we can report favourably upon Duroline for Wardian cases. We also think it might be used for many purposes in the roofing of sheds and plant structures in tropical countries.

Ophiopogon japonicus.—Specimens of this plant were recently sent to Kew for identification by H. Labouchere, Esq., M.P. "About the "Lake of Como, in many of the villas, they have a sort of grass which "they call 'erba japonica.' Its advantage is that it grows thickly "beneath the trees or in the sun, and stands the frost. It makes a "thick bed, and they use it for borders or for spaces that they wish to "cover, in the latter case cutting it short. . . . . It seems to me "that if it were introduced here it would be useful for gardens and "shrubberies. I never saw it except about Como, and I was told that "it was introduced there by the Grand Duke of Saxe-Meiningen, who "has a villa there." According to the 'Genera Plantarum," the name given at the head of these notes is the one which should be employed. It is met with in some French gardens under the name of *Convallaria japonica* (herbe aux turquoises), and in some books as *Flueggia japonica*, the name adopted by Mr. J. G. Baker when he monographed this genus and its allies. In "Garden and Forest" for 1889 Mr. Nicholson, in notes on gardens, &c., about Lugano, thus writes: —"As an edging (and a capital one too) for shady walks, and also as a "sort of turfy covering to the bare ground under the dense shade of trees, "*Flueggia japonica* was successfully employed. A pretty little "plant, with dark green grassy leaves and blue berries . . . . . ; "there being not many things which thrive under these condi- "tions, it seems desirable to call special attention to its merits." We learn from Kaempfer that it is similarly employed in Japan and China, and also that the tuberous knobs of the rhizome are preserved in sugar and used medicinally. A figure of the plant is given in the *Botanical Magazine*, t. 1063.

The "Index Kewensis."—The appearance of the first part of this great work calls for something more than a mere record. Since the publication of the second edition of Steudel's "Nomenclator Botanicus," in 1840–1, there has been no other attempt to collect and publish the names of the thousands of plants described in the botanical literature of all nations. But Steudel's work is merely an alphabetical catalogue of

plant names, with the native countries of the plants and some other details. The "Index Kewensis" is what its title implies, as it gives references to the place of publication of each genus and of each species. The foundation of this work, on which Mr. B. Daydon Jackson and several assistants have been engaged ever since January 1882, may be claimed for the late Sir William Hooker, who had an interleaved copy of Steudel's "Nomenclator Botanicus," in which he entered, or caused to be entered, all new names as they were published. This was commenced the same year that Kew Gardens were opened to the public, and it has been continued down to the present day, though there are doubtless some arrears in species. The practice is to post up, at least, all names of plants that are laid into the herbarium, and all names of new genera published in all the new books acquired for the library. Some years ago Sir William Hooker's interleaved "Steudel" was so full of manuscript that it was necessary to take some fresh step. Accordingly two copies of Steudel were procured and mounted on large folio paper, one column on each page, leaving two blank columns for the manuscript additions. The whole forms four huge folio volumes, and was prepared and continued chiefly at the expense of the late Mr. G. Bentham. In this way Mr. Daydon Jackson had something approaching a complete list of names of plants to start with, and he has during the last 11 years laboured continuously at the superstructure, the first part of which was in the hands of botanists early in September. For the history of the publication of the "Index Kewensis" we cannot do better that quote Sir Joseph Hooker's brief preface to the work :—

"Shortly before his death, Mr. Darwin informed me of his intention to devote a considerable sum in aid or furtherance of some work of utility to biological science; and to provide for its completion, should this not be accomplished during his lifetime. He further informed me that the difficulties he had experienced in accurately designating the many plants which he had studied, and ascertaining their native countries, had suggested to him the compilation of an Index to the Names and Authorities of all known Flowering Plants and their Countries, as a work of supreme importance to students of Systematic and Geographical Botany, and to horticulturalists, and as a fitting object of the fulfilment of his intentions.

"I have only to add that, at his request, I undertook to direct and supervise such a work; and that it is being carried out at the herbarium of the Royal Gardens, Kew, with the aid of the staff of that establishment."

Sir Joseph Hooker himself has most generously devoted an immense amount of time to the herculean and monotonous task of revision, and has brought his vast personal knowledge to bear on the independent but by no means inconsiderable task of settling the geographical distribution. Mr. Daydon Jackson estimates that the complete work will contain about 400,000 names and many more references; and the first part contains nearly 110,000 names. The period covered is from the establishment of binominal nomenclature by Linnæus down to the end of 1885. If nothing occurs to hinder the present rate of progress the whole work will be issued by the middle of 1895.

Africa.—Kew has received, through Mr. A. J. Swann, a third instalment of dried specimens collected by Mr. Alexander Carson in the neighbourhood of Lake Tanganyika. The parcel contains 138 numbers,

representing about 90 species. The most interesting of these are a new genus of Tiliaceæ, with digitate leaves, allied to *Honckeneya*, which will be figured and described by Professor Oliver in Hooker's *Icones Plantarum;* a new species of the curious Euphorbiaceous genus *Synadenium;* a new species of the Boraginaceous Cape genus *Lobostemon*, only gathered once before in Tropical Africa; a new *Moræa*; a new *Lapeyrousia* and six new *Gladioli*, two of which have large flowers, and would be valuable as garden plants.

Disporopsis.—Two sheets of specimens, without flowers, which have been for some time in the herbarium, prove, on comparison with the type in the British Museum to belong to the curious Liliaceous genus *Disporopsis*, described by the late Dr. Hance, in the "Journal of Botany," 1883, p. 278. This genus resembles in habit *Disporum* and *Polygonatum*, but differs from both of these in possessing a corona, which springs from the throat of the perianth-tube in a similar manner to that of *Narcissus*. This corona is slightly shorter than the perianth lobes, tubular and divided rather more than half-way down into six segments, each of which is bifid at the apex. The six stamens alternate with the segments of the corona. *D. fusco-picta*, Hance (the only known species) has a creeping rizome, from which spring numerous erect branches about six inches high, bearing solitary, cernuous, white flowers in the axils of the leaves. It was first found by the Rev. E. Faber on the Lofau mountains, near Canton, and subsequently collected by Dr. A. Henry, at Kuei (No. 6,168) and Fang (No. 6,705), both in the province of Hupeh. It has not yet been brought into cultivation.

Shantung Cabbage (*Brassica chinensis*, L.)—In the *Kew Bulletin* for May 1888, p. 137, an account was given of this Chinese vegetable, of which seeds had been sent to the Royal Gardens in the preceding year by Mr. George Hughes, late Commissioner of Customs at Chefoo, China. Plants raised from them ripened a good crop of seeds at Kew, which were distributed to a few correspondents interested in new vegetables. The following notice is taken from the "Garden," November 18, 1893, p. 472:—

"Being specially fond of vegetables, I tried a few years since some seeds of Shantung cabbage, for which I was indebted to Kew. For two years I thought it worthless, its open heartless heads running up to seed very quickly. But this year I sowed the remains of my seed, and yesterday a dish of what appeared to be beautifully white Cos lettuce was brought to me. Boiled, at dinner, I found it most insipid and worthless, simply so much tender green vegetable between the tongue and teeth, with absolutely no flavour to the palate. To-day I have tried it as a salad, and I find it excellent, white, crisp, and sharp as the best summer Cos lettuce. Worthless as a vegetable, but of great value as supplying an excellent late autumn salad.

"R. Milne-Redhead.

"Holden Clough."